Environment Canada Environnement Canada

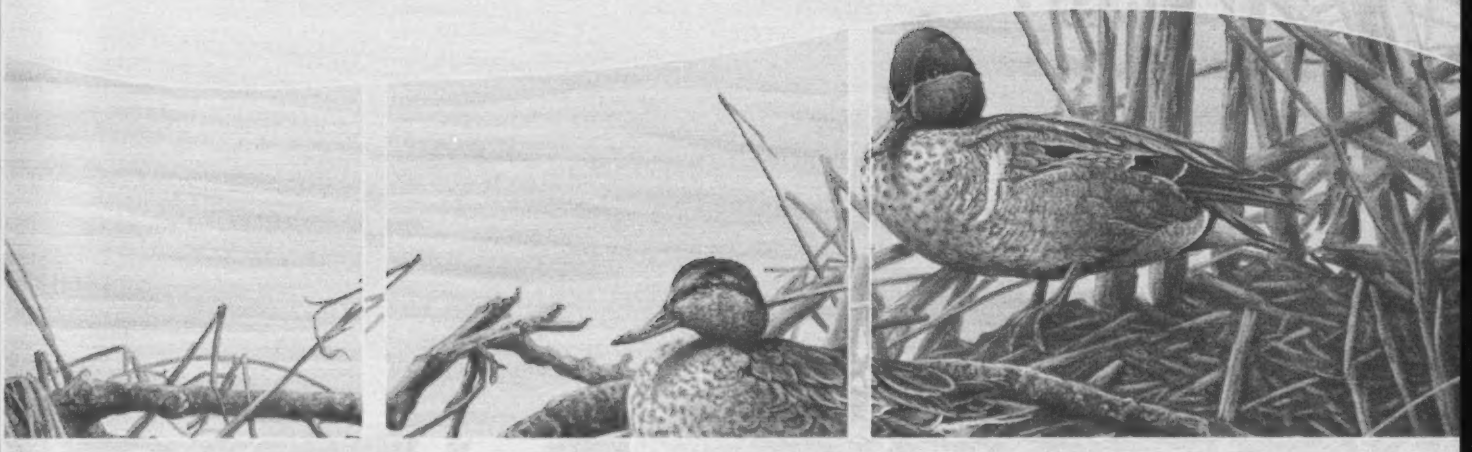
Population Status of Migratory Game Birds in Canada

(and Regulation Proposals for Overabundant Species)

November 2010

Canadian Wildlife Service
Waterfowl Committee

CWS Migratory Birds Regulatory Report Number 31



Canada

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Comments:

Comments regarding this report, the regulation-setting process or other concerns relating to national migratory game birds should be sent to the Director of Population and Conservation Management Division at the national office of the Canadian Wildlife Service of Environment Canada at the following address:

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Background

Canadian hunting regulations for migratory game birds are reviewed annually by Environment Canada, with input from the provinces and territories and a range of other stakeholders. As part of this process, the Canadian Wildlife Service (CWS) of Environment Canada produces three reports each year. The first report, *Population Status of Migratory Game Birds in Canada (commonly called the November report)*, contains population and other biological information on migratory game birds, and thus provides the scientific basis for management. The second report, *Proposals to Amend the Canadian Migratory Birds Regulations (the December report)*, outlines the proposed changes to the annual hunting regulations, as well as other proposed amendments to the *Migratory Birds Regulations*. Proposals for hunting regulations are developed in accordance with the *Objectives and Guidelines for the Establishment of National Regulations for Migratory Game Bird Hunting* (www.ec.gc.ca/rcom-mbhr/default.asp?lang=En&n=/rcom-mbhr/default.asp?lang=En&n=56286e6c-9).The third report, *Migratory Birds Regulations in Canada*, summarizes the hunting regulations for the upcoming hunting season. The three reports are distributed to organizations and individuals with an interest in migratory game bird conservation, to provide an opportunity for input to the development of hunting regulations in this country.

Data presented in the *Population Status of Migratory Game Birds in Canada* report come from a variety of sources. Breeding population estimates and trends for inland ducks are derived from large-scale systematic aerial surveys conducted annually in eastern and western Canada and parts of the United States. Additional small-scale, usually annual, breeding waterfowl surveys are also conducted in other parts of this country. Information on sea duck populations comes mainly from surveys limited to a few key locations or a small portion of the species' range, and are conducted during the breeding, moulting or overwintering period. Goose population estimates and trends are derived mainly from specific annual or occasional surveys carried out during the breeding season or, in some cases, during migration. Additional information on waterfowl populations is also provided by mid-winter surveys on the wintering grounds conducted annually in the four U.S. flyways. Population information on swans and other migratory game birds is derived from specific breeding or wintering surveys or countrywide breeding bird surveys. Harvest levels of migratory game birds in Canada and the United States are estimated through national harvest surveys and, in some cases, through species-specific surveys. From 1961 through 2001, estimates of waterfowl harvest in the U.S. were derived from the U.S Fish and Wildlife Service's Waterfowl Questionnaire Survey. However, a new survey, the Harvest Information Program (HIP), was fully implemented in 1999. In addition to waterfowl, it gathers information on species and groups of migratory game birds such as woodcock, doves and snipe. Harvest estimates yielded by the two surveys can not be directly compared.

Population Status of Inland Ducks

Eastern Canada

In Eastern Canada, breeding waterfowl populations are monitored annually through the Eastern Waterfowl Breeding Ground Survey (hereafter Eastern Waterfowl Survey). The CWS carries out a systematic helicopter survey over the Boreal Shield region from northeastern Ontario to Newfoundland and Labrador, and the Atlantic Highlands region from the Gaspé Peninsula in Quebec to Nova Scotia. The U.S. Fish and Wildlife Service conducts a fixed-wing aerial survey in parts of Eastern Canada and the northeastern U.S. (Figure 1). This work has been evolving since 1990, originating as part of the Black Duck Joint Venture of the *North American Waterfowl Management Plan* (NAWMP). The surveys are designed and timed primarily to provide reliable breeding population estimates and trends for the American Black Duck, an early-nesting species.

Historically, the data from these surveys (CWS and USFWS) have been analyzed separately, despite some overlap in geographic coverage. In 2004, the CWS and the USFWS agreed to integrate the two surveys to reduce the extent of overlap and expand the geographic region covered. The data presented in this report represent an integration of the results of the two survey platforms. In time, all survey results will be integrated for reporting on a regional basis.

Additional breeding population surveys are also conducted in some parts of Eastern Canada although they are presently not included in the integrated Eastern Waterfowl Survey. On Prince Edward Island, an annual breeding waterfowl survey of ground plots has been in place since 1985 and conducted cooperatively with the P.E.I. Fish and Wildlife Division. In southern Ontario, a breeding waterfowl survey of ground plots was conducted by the CWS at three- to five-year intervals from 1971 to 2004. In 2005 it was changed to an annual survey employing a rotating sample of the original plots. In 2008 the first four-year rotation was completed. Finally, beginning in 2004, surveys along the St. Lawrence River shoreline and in the lowlands of

southern Quebec were added to assess the value of these areas to breeding waterfowl on a regular basis. A similar experimental aerial survey program to assess waterfowl breeding in agricultural landscapes in New Brunswick and Nova Scotia was initiated in 2008. This program is supported by the Eastern Habitat Joint Venture and was expanded in 2009 and 2010 to include agricultural land on Prince Edward Island.

In this section, we summarize information on inland duck populations in Eastern Canada.

American Black Duck

There is some concern over American Black Duck (*Anas rubripes*) populations in North America. Mid-winter inventories in the Atlantic and Mississippi flyways showed a decline in the continental population between 1955 and the early 1980s, when numbers stabilized at a low level (Figure 2). The total number of Black Ducks counted in both flyways combined in winter 2010 (223 472) was 5% higher than the 2009 count (211 938), and is 6% below the 2001-2010 average (237 574). In 2010, the estimated population of Black Ducks in the Atlantic Flyway was 203 030 and in the Mississippi Flyway was 20 442 (Fronczak 2010).

Surveys of American Black Ducks on their wintering areas are useful for studying overall population trends, but they are not effective for evaluating the status of breeding populations, because of the mixing of birds from diverse breeding areas. In the area covered by the Eastern Waterfowl Survey, the integrated index of the number of indicated breeding American Black Ducks is shown in Figure 3. The 2010 Eastern Waterfowl Survey estimate was 444 200 Black Ducks, which was 5% lower than the 2009 estimate and 11% lower than the 10-year average of 500 630. Trends appear to be relatively stable for most survey strata, except for the Western Boreal Shield where the trend is declining.

The long-term trend (1971-2010) for American Black Ducks in southern Ontario indicates a slight decline (Table 1); however, the most recent 10-year trend (2000-2010) shows a more positive outlook but it must be noted that this survey does not cover the core breeding range of the American Black Duck in Ontario.

The decline of American Black Ducks on their wintering grounds prompted the United States to initiate a program to reduce the harvest of the species in 1983; Canada joined the initiative in 1984. Between 1984 and 1988, the harvest in the U.S. gradually decreased, while it remained relatively the same in Canada (Table 2). In 1989 and 1990, however, Canada successfully implemented more restrictive Black Duck hunting regulations in order to protect local breeding populations. The 2009 harvest estimate was 90 617 Black Ducks, slightly below the average of the previous five years (98 543). The estimated continental harvest in 2009 was 202 497 Black Ducks, which is the lowest value since 1974 (Table 2). The continuing general trend of decreasing harvest in Canada is thought to be at least partly related to a decline in the number of waterfowl hunters.

Other Inland Duck Species

Eastern Waterfowl Survey

The Eastern Waterfowl Survey of Eastern Canada (Figure 1), though originally designed to survey Black Ducks, provides quantitative information on other inland duck species that can be used to evaluate the status of their breeding populations. The range-wide integrated indices for the number of indicated breeding birds of the most abundant eastern dabbling and diving duck species are plotted in Figures 4a to 4c.

Mallards (*Anas platyrhynchos*) decreased in 2010 compared to the previous year, in all four regions (Figure 4a). American Green-winged Teal also showed a decrease in all regions, except in the Atlantic Highlands. Ring-necked Ducks continue to do well, particularly in the eastern and central regions (Figures 4b and 4c).

Southern Ontario Waterfowl Plot Survey

Results of the ground-based breeding waterfowl survey in southern Ontario are graphed in Figures 5a and 5b for the more common species encountered. Trend estimates are also presented for both the 1971–2010 and 1992–2010 periods (Table 1). Among the dabbling ducks, only Blue-winged Teal has exhibited long-term declines (-6.8%) to very low numbers in the southern Ontario survey area (7669 pairs). The breeding population of Mallard, the most abundant duck species in southern Ontario, has remained essentially stable since 1984; in 2010, there were just over 175 000 pairs of Mallards in southern Ontario. Wood Ducks show a steady increase from 2000 (8.7%) and are the second most abundant duck species in this area (just over 105 000 pairs in 2010). Although Green-winged Teal is showing a recent slightly negative trend (-5.2%), it must be noted that southern Ontario is not part of the core breeding area of this species. For diving ducks, both Common and Hooded Mergansers show long-term (from 1971) increases in their breeding populations. Recent population estimates for Hooded Merganser and Ring-necked Duck show increasing trends; 10.2% and 2.3% respectively, from 2000-2010. The 2010 estimates for all species are comparable with historical estimates. Annual

population estimates for some species such as Green-winged Teal can be highly variable, reflecting the presence of large numbers of migrating individuals captured by the survey during some years.

Canadian Prairies and Western Boreal Canada

Breeding waterfowl populations are monitored annually through the Waterfowl Breeding Population and Habitat Survey of Western Canada (U.S. Department of the Interior and Environment Canada 1987). The traditional survey area encompasses the Canadian Prairies and Western Boreal Canada (northwestern Ontario to Old Crow Flats in the Yukon), as well as the north-central United States (U.S. Prairies) and parts of Alaska (Figure 6). The U.S. Fish and Wildlife Service (USFWS) and the CWS have been conducting this survey, using fixed-wing aircraft in combination with ground counts, since 1955. Breeding population estimates have been corrected for visibility bias since 1961.

In this section, we summarize information on inland duck populations in the Canadian Prairies and Western Boreal Canada. Summaries of the results by province and territory can be found in Schuster (2010).

Breeding Habitat Conditions in the Prairie Pothole Region

In the Prairie Pothole Region (Canadian and U.S. Prairies), weather has a strong influence on waterfowl breeding habitat conditions and, consequently, on the abundance of waterfowl populations. Drought in the late 1980s and early 1990s created particularly difficult breeding conditions for ducks. Spring habitat conditions (as measured by the number of ponds in May) improved into the late 1990s from the drought levels of the late 1980s and early 1990s (Figure 7). In 2010 the total pond estimate (prairie Canada and U.S. combined) was 6.7 ± 0.2 million ponds. This was similar to the 2009 estimate and 34% above the long-term average of 5.0 ± 0.03 million ponds (USFWS 2010).The 2010 estimate of ponds in the Canadian Prairies was 3.7 ± 0.2 million ponds. This was a 5% increase from last year's estimate (3.6 ± 0.1 million) (Figure 7). An analysis of trends showed significant increases ($P < 0.05$) in the number of ponds in the Canadian Prairie Pothole Region during the last 10 years (2001–2010); however, over the short term (2006-2010) the trend showed significant decreases. The long-term (1974-2010) trend in pond numbers for the Canadian Prairies shows a slight decline (-0.1%), but it is not significant (Table 3).

Mallard

The Mallard breeding population in the traditional survey area had recovered from the decline seen in the 1980s, but in 2001, it dropped below the NAWMP goal of 8.20 million (Figure 8), and remained there until 2006. Between 2007 and 2009, the Mallard breeding population index in the traditional survey area oscillated around the NAWMP goal. In 2010, the Mallard breeding population index was 8.4 million birds, 3% above the NAWMP goal. There is no significant trend over the short or long term (Table 3).

The 2010 Canadian Prairie breeding population index (2.65 million) was 13% lower than in 2009 (3.04 million), and well below the NAWMP goal of 4.37 million birds for the region (Figure 8). The five-year trend shows a significant decline ($P < 0.05$, Table 3). In Western Boreal Canada, the Mallard breeding population index was 10% higher compared to the previous year, with an estimated 2.24 million birds (Figure 8). The five-year trend shows a significant increase in this region (Table 3).

The continental harvest of Mallards during the last several years increased considerably compared to the late 1980s and early 1990s (Table 4), reflecting the large growth in this population. This increase in harvest has occurred entirely in the U.S., whereas harvest levels have stabilized in Canada. In 2009, it was estimated that 4.1 million Mallards were killed in the U.S., a decrease of 9% from the previous year. In 2009 in Canada, the estimated harvest was 472 527 birds killed, a decrease of 14% compared to 2008 (547 628), and the lowest harvest ever recorded. Overall, when compared to 2008, the continental harvest of Mallards in 2009 decreased by 10% to 4.6 million birds (Table 4).

Northern Pintail

Following the dramatic decline in abundance in the 1980s, the breeding population of Northern Pintail (*Anas acuta*) in the entire traditional survey area showed signs of recovery, increasing to 3.6 million birds by 1997 (Figure 9). Thereafter, pintail numbers again declined, reaching a historic low in 2002. From 2003 to 2009, the population increased and oscillated between 2.56 and 3.22 million. In 2010 the population was estimated at 3.51 million birds. Even with the increases seen since 2002, the population size continues to be far below the NAWMP goal of 5.56 million birds (Figure 9). The status of this species is the focus of NAWMP's Northern Pintail Action Group, which hopes to identify and mitigate the key factors driving the declining trend.

During the 1970s, the Canadian Prairies supported about half of the pintails in the traditional

survey area. The decline of that region's breeding population has therefore had major repercussions for the size of the continental breeding population, and has been compounded by declines in the smaller populations of the U.S. Prairies and Western Boreal Canada (Figure 9). The long-term population declines in all three regions are significant ($P < 0.05$, Table 3), as is the long-term decline for the entire traditional survey area. Alaskan pintails remain the only population component not demonstrating a long-term decline in numbers (Table 3).

Although the breeding population of the Canadian Prairies has rebounded sharply in the past 10 years, Table 3 shows that the population has experienced significant average long-term and short-term declines ($P < 0.05$). The 2010 breeding population in the Canadian Prairies declined to 591 945 birds, a drop of 11% from the 663 979 birds estimated in 2009, and is far below the NAWMP population goal of 3.30 million. In Western Boreal Canada, Northern Pintail numbers increased by 23% in 2010 to 364 242 birds (Figure 9). In spite of this increase, this population remains below the NAWMP goal of 407 000 pintails for that region. The long-term trend indicates a significant decline ($P < 0.05$), but the five-year trend shows a significant increase ($P < 0.05$, Table 3).

The total annual harvest of Northern Pintails dropped with the population decline that began in the 1980s. The continental harvest gradually rose during the mid-1990s (Table 5), reflecting the increase in estimated pintail numbers during the same period. Between 2002 and 2004, both the estimated breeding population and harvest dropped again. Since then, continental harvest numbers have been increasing every year, from 450 077 in 2005 to 587 459 in 2008. This increase was driven by increases in US harvest. The estimated continental harvest declined in 2009 with 539 068 birds killed. In Canada, the harvest remained relatively stable between 2005 and 2009. For 2009 the estimated harvest in Canada was 40 306 birds (Table 5).

Other Dabbling Ducks

Other dabbling duck species monitored under the Waterfowl Breeding Population and Habitat Survey are Blue-winged Teal (*Anas discors*), Gadwall (*A. strepera*), Green-winged Teal (*A. crecca*), American Wigeon (*A. americana*), and Northern Shoveler (*A. clypeata*). The abundance of Blue-winged Teal, Gadwall, American Wigeon and Northern Shoveler decreased in 2010 relative to 2009, while Green-winged Teal increased slightly (Figures 10 through 14). All species but the American Wigeon show significant positive long-term trends (Table 3); the long-term trend for the Wigeon is declining, but not significantly ($P < 0.05$). American Wigeon is the only one of the five not currently at or above its NAWMP population goal (Figures 10 to 14). For all species there were decreases in the 2010 population estimates for the Canadian Prairies. (Figures 10 through 14).

American Wigeon increased in 2007 for the first time since 1997, approaching the continental NAWMP goal of 2.97 million birds; however, in 2008 the population dropped by 11% from 2007 to an estimated 2.5 million birds and stayed at this level in 2009 (Figure 13). In 2010, the population continued to show a decline (2.4 million). The most significant decline has taken place in the Canadian Prairies, where this species has sustained an average decline of 2.3% per year (Table 3). The Canadian Prairies population of American Wigeon has not recovered to the levels seen in the 1970s and at 328 027 birds remains far below the NAWMP goal of 1.16 million for the region.

Scaup

Lesser Scaup (*Aythya affinis*) and Greater Scaup (*A. marila*) are not treated separately in the Waterfowl Breeding Population and Habitat Survey because it is difficult to differentiate among them from fixed-winged aircraft. Nonetheless, Lesser Scaup is the much more abundant species (Austin *et al.* 1999). Scaup breeding populations are in decline in the traditional survey area (Figure 15), with significant ($P < 0.05$) declines in breeding numbers observed over the long term (Table 3). After several years of decline, the scaup population increased in 2010 to pre-2000s levels (4.24 million birds), but remained well below the NAWMP goal of 6.30 million.

The combined population size of Lesser and Greater Scaup in Western Boreal Canada accounts for more than half of the continental total. The declining trend for the entire traditional survey area is largely a reflection of significant reductions in the Western Boreal region's breeding population (Figure 15). At 2.67 million birds estimated in 2010, the number of scaup in Western Boreal Canada remains well below the NAWMP population goal of 4.3 million birds and it is declining by 1.6% every year (long-term decline; Table 3). However, the Western Boreal breeding population showed significant five-year trend increase (16.8% per year; $P < 0.05$). In 2010, the Canadian Prairie breeding population was estimated at 425 340 birds. This population shows significant long- and short-term declines ($P < 0.05$, Figure 15, Table 3). The scaup breeding population in the Canadian Prairies also remains well below the NAWMP goal of 1.05 million.

The harvest of Lesser and Greater Scaup has declined considerably in Canada over time (Tables 6 and 7), possibly reflecting the decline in scaup

populations. In 2009, the Canadian harvest of Lesser and Greater Scaup was estimated at 27 399 and 5096 birds, respectively, which in both cases represents a decrease over 2008 (28% and 7% respectively).

The scaup harvest has been quite variable in the U.S. (Tables 6 and 7). Harvest of Lesser Scaup declined sharply in the late 1980s and early 1990s (~150 000 birds killed), but increased considerably from 1995 to 1998 (average of 453 889 birds killed), and decreased again in the 2000s. In 2009, the Lesser Scaup harvest in the U.S. of 222 067 birds represented an increase of 24% compared to 2008 and a decrease of 20% compared to the previous 10-year average harvest (278 932). The Greater Scaup harvest has also declined over the years in the U.S., except for the substantial increases in 2002, 2004 and 2007. The estimated harvest was 55 139 birds in 2009 (11% higher than in 2008), and similar to the average harvest estimate of 54 780 killed per year in the last 10 years.

The continental harvest of Lesser Scaup increased by 15% to 249 466 birds in 2009. Similarly, the continental harvest of Greater Scaup was up by 4% to 60 235 birds in 2009.

Other Diving Ducks

The other diving duck species monitored as part of the Waterfowl Breeding Population and Habitat Survey are the Canvasback (*Aythya valisineria*), Redhead (*A. americana*), Ring-necked Duck (*A. collaris*), and Ruddy Duck (*Oxyura jamaicensis*).

The breeding population of Canvasbacks in the Canadian Prairies has recovered somewhat from the population decline seen during the 1980s and early 1990s. The population has fluctuated widely in recent years (Figure 16). Canvasback shows no significant trend in any stratum of the traditional survey area over the long-term period; however, Alaska, Western Boreal and Canadian Prairies showed significant short-term declines (Table 3). At 585 164 Canvasbacks in 2010, this population is slightly above the NAWMP goal of 541 868 (Figure 16).

The Canadian harvest of 10 108 Canvasbacks in 2009 was an increase from 2008, and was also above the 10-year average (8725; Table 8). The harvest in the U.S. has varied over the long term. The USFWS closed the 2008 hunting season for Canvasback. The 2009 U.S. harvest was estimated at 70 393 birds, which is above the average over the last 10 years (69 713; Table 9).

The variable trend in Canvasback numbers can also be seen in Redhead trends (Figure 17). The current count of 1.06 million birds is similar to the number estimated in recent years (Figure 17). Redhead populations are above the NAWMP goal for the entire survey. Redheads also show a significant increasing trend of 1.0% per year over the long term in the traditional survey area.

The Ring-necked Duck population shows an increasing trend of 2.6% per year over the long term (Table 3; Figure 18). Ruddy Ducks are also doing well, with a significant increasing trend of 1.9% per year over the long term in the traditional survey area (Table 3; Figure 19).

Southern Yukon

Spring 2010 (March-May) was 3-to-4 degrees above normal, with precipitation ranging from normal in the north to 20% below normal in the south. In the larger region (North British Columbia Mountains/Yukon), this was the 2nd warmest spring in 63 years at 3.8 degrees above normal, and the 23rd driest. Snowpacks were near normal as of April 1. By May 1 snowpacks were still near normal west and south of Whitehorse, but were only 50-70% of normal in the remainder of Yukon.

Summer (June-August) temperatures were slightly above normal, while precipitation ranged from 20% below normal in the south to normal in the north. In the larger region (North British Columbia Mountains/Yukon), this was the 15th warmest summer in 63 years at 0.8 degrees above normal, and the 5th driest summer in 63 years at 21% below normal.

Migration of dabbling ducks (as measured by counts at Marsh Lake) was possibly the earliest in 23 years of record, with peak numbers of Mallards 2-3 days earlier than in the previous years (1994, 2004 and 2005). Trumpeter Swan migration was the earliest on record (approx. 35 years).

This was the 20th year of the Cooperative Yukon Roadside Waterfowl Breeding Population Survey. Surveys were conducted five times between early May and mid-June 2010 on approximately 270 wetlands along the road system in Southern Yukon. For each survey, indicated pairs were calculated using standard operating procedures. To minimize missing data, a sample of 142 wetlands was chosen from the 270 to look at the entire 19-year record. The numbers presented in Figures 21-24 are the total number of indicated pairs on these 142 wetlands from all five surveys each year.

All duck species were below 2009 values, with the greatest being Northern Pintail (-44%) and Ring-necked Duck (-40%). Over the longer term (5, 10, 15 and 19 years), there are few significant trends. Scaup continue a dramatic long-term decline which is highly significant for three of the four periods. American Wigeon have a slight 15-year decline but no trend over the past 5 or 10 years. Two species in the survey are increasing dramatically: Gadwall and

Trumpeter Swan (J. Hawkings, pers. comm.).

Interior British Columbia

Weather across B.C. over the 2009-2010 winter was dominated by the effects of a moderate El Niño. Most of the province experienced above-normal temperatures in January, February and March 2010 that resulted in significant winter snow melt. Winter snowfall and snowpacks were below average for the B.C. Interior and water levels were very low overall. For a fourth consecutive year, habitat conditions were poor in the lower elevation portions of the B.C. Interior in May 2010. Two major surveys have been used to estimate trends in duck populations in British Columbia: a large-scale (11 million hectare) aerial survey of the B.C. Interior and a replicated series of ground counts covering selected wetlands of the Southern and Central Interior Plateau of B.C. Ground counts were modified in 2007 to focus on managed and protected wetlands (habitat assessments). Aerial surveys of breeding waterfowl were conducted in the Central Interior Plateau of British Columbia in May 2006, and repeated annually since, over an area in excess of 10 million hectares. The survey used a strip-transect total count method similar to the one used for the mid-continent breeding waterfowl survey, although all waterfowl sightings are geo-referenced and associated with a unique habitat type (i.e. stream, wetland, river, lake, agricultural field) and ecological unit (ecosection) to allow for the subsequent determination of ecosystem-specific, habitat-to-species relationships and the development of landscape use models. The waterfowl population of the Central Plateau was estimated at 486 585 birds ± 7166 (95% confidence interval) in May 2010, with Mallard being the most abundant species (21.6% of the total). The overall estimate is 2% higher than the 475 905 breeding waterfowl estimated in 2009.

Population Status of Sea Ducks

There is concern about the population status of most of the sea duck species (tribe *Mergini*) that breed in North America. Because many breed at low densities in remote parts of the continent and cover a broad geographic area, it is difficult to gather adequate information on their ecology and population dynamics. Consequently, sea ducks are poorly understood and few reliable population indices or estimates of annual productivity exist for any of the species. Harvest levels are also poorly understood. In comparison to other waterfowl, sea ducks have low reproductive rates, which means that population maintenance is highly sensitive to adult mortality. There is therefore limited potential for quick population recovery. Because of increasing concern about the status of sea ducks, the NAWMP Committee created the Sea Duck Joint Venture (SDJV) in 1998. The SDJV recently undertook a review of monitoring needs for sea ducks and made recommendations regarding the development and testing of various surveys (see www.seaduckjv.org/). As an example, starting June 2005 a fixed-wing aerial survey was conducted annually in parts of central and western arctic Canada (Conant *et al.* 2007). The survey followed a design of systematically placed transects in areas of known or suspected high densities of waterfowl and waterbirds (Cornish and Dickson 1996; Hines *et al.* 2003; Alisauskas 2005). Provided adequate funding can be obtained, this will become an annual survey, thus improving utility of the survey to detect trends in Western King Eiders, Long-tailed Ducks and several other arctic waterfowl species.

Harvest information is estimated through the national harvest survey programs in Canada and the United States. However, harvest estimates are imprecise for some sea duck species due to small sample sizes.

Eiders

Reviews by Suydam (2000), Gilchrist and Dickson (1999), Dickson (1996; 1997) and the Joint Working Group on the Management of the Common Eider (2004) provide useful summaries of what is known about eider species that breed in Canada, i.e. the King Eider (*Somateria spectabilis*) and Common Eider (*S. mollissima*).

King Eiders nesting in the Canadian Arctic overwinter in both the eastern and western parts of the continent. Since King Eiders form pairs on the wintering areas, there may be two distinct populations, although genetic differences have not been identified to date (Pearce *et al.* 2004). For Common Eiders breeding in northern Canada, three subspecies are recognized: the Pacific subspecies *Somateria mollissima v-nigra* (western and central Arctic), the northern subspecies *borealis* (eastern Arctic), and the Hudson Bay subspecies *sedentaria* (Hudson Bay and James Bay). A fourth race, the American subspecies *dresseri*, breeds in Southern Quebec and the Atlantic provinces.

King Eider

Western Arctic Population

There is growing evidence that the western Arctic population of King Eiders has declined considerably in the last few decades. Spring counts of eiders migrating past Point Barrow, Alaska, indicate that the King Eiders breeding on the Arctic

coastal plain of Alaska and in the western and central Canadian Arctic declined by more than 50% between 1976 (800 000 birds) and 1996 (350 000) (Suydam 2000). Aerial surveys conducted in the western Canadian Arctic in 1991–1994, together with the work by Alisauskas (1992) in the Queen Maud Gulf, have provided a breeding population estimate of about 200 000 to 260 000 King Eiders in the western and central Canadian Arctic (Dickson *et al.* 1997). This estimate is considerably lower than the estimate of 900 000 by Barry (1960) 40 years earlier, which suggests a substantial decline in the abundance of the western Arctic population (Dickson *et al.* 1997). The breeding population surveys conducted on western Victoria Island in 1992–1994 were repeated in 2004–2005. Results indicate that King Eiders in that part of their breeding area declined by an additional 50% during the past decade (Raven and Dickson 2006). Reasons for the decline are unknown.

Movement between nesting, moulting and wintering areas has been documented for 42 King Eiders tagged with satellite transmitters on Victoria Island and Banks Island, N.W.T., and Prudhoe Bay, Alaska. The results show the majority of western King Eiders moult and winter off the east coast of Russia (L. Dickson, pers. comm.). King Eiders banded in the central Arctic, in the Queen Maud Gulf, have been recovered near Alaska as well as near Greenland (R. Alisauskas, pers. comm.).

Nearly all (99%) of the western Arctic eiders harvested in Canada are taken near the community of Holman on western Victoria Island, N.W.T. (Fabijan *et al.* 1997). A three-year study was conducted at Holman to further our understanding of the impact of the town's subsistence harvest on the area's eider subpopulations. Hunters from Holman harvested an estimated 4–7% of the King Eider subpopulation and less than 1% of the Common Eider subpopulation available to the community. The present levels of harvest at Holman are likely sustainable. However, more information on recruitment rates and mortality, including harvest in Russia, is needed to confirm this (L. Dickson, pers. comm.).

Eastern Arctic Population

A review of available data on the wintering grounds in Greenland has shown a substantial decrease in the numbers of wintering and moulting King Eiders and suggests that the eastern Arctic population is declining. It is not known if this apparent decline represents a shift in distribution due to human disturbance (Suydam 2000). In the Rasmussen Lowlands of Nunavut, however, a significant decline in the numbers of King Eiders was seen between 1974–1975 and 1994–1995 (Gratto-Trevor *et al.* 1998). These findings support the concerns expressed by hunters in the area that numbers are declining (Johnston *et al.* 2000). In February 2010, CWS conducted exploratory surveys in parts of Hudson's Strait and Frobisher Bay. These surveys confirmed the occurrence of large numbers of wintering King and Common Eiders at the northern tip of Labrador and southern tip of Baffin Island (S. Gilliland and C. Lepage unpubl. data) with small numbers of birds occurring on the eastern side of Ungava Bay and in Frobisher Bay. The east coast of Baffin Island has not been explored, but anecdotal observations by helicopter pilots suggest concentrations of eiders may winter there as well (J. Innis, pers. comm.).

In the eastern Arctic, available harvest data for eiders is limited. However, the harvest of eiders (King and Common eiders combined) in southwest Greenland is estimated at over 100 000 birds annually. A large proportion of this harvest consists of Canadian breeding birds, since the breeding population of Common Eiders in western Greenland is likely only 20 000 pairs, based upon recent surveys (G. Gilchrist, pers. comm.). The largest eider harvests in Canada occur in Newfoundland, where about 10% of the harvest may be comprised of King Eiders (Gilliland and Robertson 2009).

Pacific Common Eider

Migration counts at Point Barrow provide evidence pointing to a considerable decline in the population of Pacific Common Eiders in recent years. Counts during spring migration show a decline of more than 50% between 1976 and 1996 (Suydam *et al.* 2000). Reasons for the decline are unknown.

Surveys during spring migration in the late 1980s suggested that more than half of the Pacific Common Eiders that breed in Canada nest in Dolphin and Union Strait, Coronation Gulf, and Queen Maud Gulf (Hoover and Dickson 2007). To document the size and location of nesting colonies, provide a breeding population estimate for the region, and establish a baseline for monitoring Pacific Common Eider populations in future, aerial and ground surveys were conducted over three years beginning in 1995. The breeding population for the central Arctic was estimated at about 37 000 and the primary nesting areas were identified as southeastern Dolphin and Union Strait, outer Bathurst Inlet, Melville Sound, Elu Inlet and central Queen Maud Gulf (L. Dickson, pers. comm.).

Aerial surveys in late June in Bathurst Inlet area were conducted in 1995, then again in 2006–2008 to establish a baseline for monitoring Pacific Common Eider breeding population trends (Raven and Dickson 2008). At a subset of 24 colonies in the same area, nest success and annual survival of adult females were monitored over a seven-year period starting in 2001 (Hoover and Dickson 2007).

Satellite telemetry of 47 eiders from a nesting colony near Bathurst Inlet, Nunavut, indicated these eiders winter off the southeast coast of Chukotka Peninsula, Russia (L. Dickson, pers. comm.). About one-third of the males also moult off Russia. Harvest information for eastern Russia is limited, but suggests a substantial take of eiders. A rough estimate of the subsistence harvest in 2001 in Chukotka was 115 000 eiders (from four different species) (E. Syroechkovski Jr., pers. comm.). However, it is not known what percentage of this take is Pacific Common Eiders from Canadian breeding grounds. The subsistence harvest of Pacific Common Eiders in Canada and Alaska is an estimated 2500 birds per year (Fabijan *et al.* 1997).

Northern Common Eider

The northern subspecies of the Common Eider breeds throughout the coastal areas of the eastern Canadian Arctic and Greenland, and winters along the coasts of Newfoundland and Labrador, Quebec and southwest Greenland. This race of eider is subjected to heavy subsistence and sport harvests throughout its breeding, staging and wintering grounds, especially in Greenland (F. Merkel, pers. comm.). Reliable data on population status do not exist and few key habitat sites have been identified; historical data only exist for three sites: Ungava Bay, Hells Gate (high Arctic) and Digges Sound. Recent surveys in Greenland indicate that dramatic population declines have occurred since the 1970s.

Historical data exists for the colonies in Ungava Bay (Chapdelaine *et al.* 1986) and repeated surveys conducted in 2000 provided the first meaningful population trend data for Northern Common Eiders in Canada. The results show no clear trend in the number of eiders in the three most southerly archipelagos (Gyrfalcon, Payne and Plover), but may show an increase in the nesting population. In contrast, there was a significant decline in the more northerly archipelago (the Eider islands) in the early 1980s (Falardeau *et al.* 2003). The small Northern Common Eider colonies in Digges Sound (located off the northwest tip of Quebec) were resurveyed in 1999. The survey showed no significant population trend since the early 1980s (Hipfner *et al.* 2002).

Data also exist for colonies along the Labrador coast. Results of intensive surveys of eider colonies along the lower, central and mid-Labrador coast between 1998 and 2003 suggest strong growth over this period (18% per year; Chaulk *et al.* 2005). Historical data also exists for the Labrador coast from 1980 and 1994. A repeat survey in 2006 suggests this segment of the population has been increasing at a rate of about 5% per year over this period (K. Chaulk, pers. comm.).

Avian cholera may be an emerging issue for Northern Common Eiders. The first recorded Arctic outbreaks of avian cholera were recorded in Common Eiders in 2004 (northern Quebec), 2005 (Southampton Island), and 2006–2007 (Southampton Island and northern Quebec). Many hundreds of Common Eider ducks died of avian cholera at nesting colonies in northern Hudson Bay and west Hudson Strait in July and August 2004–2005. This finding was first detected by local residents hunting in the area near Ivujivik, northern Quebec. In the summer of 2006, cholera was again detected at eider colonies along the northern coasts of Quebec in Nunavik, and at East Bay, Southampton Island, Nunavut. At East Bay over 3200 eiders (i.e. more than 40% of the nesting females) were killed between late June and early August 2006 (Gilchrist, unpubl. data).

These field studies showed that annual variation in colony attendance of Common Eiders (e.g. low attendance due to heavy ice conditions) make the interpretation of survey data difficult. Long-term annual monitoring of a subset of colonies would be useful to quantify this variation (J.-P.L. Savard, pers. comm.).

A recent review of the band recovery data of Common Eider banded in the eastern Canadian Arctic and western Greenland showed links between breeding populations and their affinities to specific wintering areas in Greenland and Maritime Canada. The majority of bands recovered from eiders banded on Southampton Island, Nunavut, since 1996 have been recovered in western Greenland during winter (G. Gilchrist, pers. comm.). Satellite telemetry of eiders during both spring and fall migration also clearly demonstrates that large proportions of the Canadian breeding population winter in western Greenland (A. Mosbech and G. Gilchrist, pers. comm.).

Collectively, these findings show that the majority (at least 75%) of Northern Common Eiders winter in southwestern Greenland rather than in Canada, as was previously thought. These findings have important management implications because they confirm that the majority of eiders harvested in Greenland during winter are part of the breeding population in Canada. Population and harvest data of the Northern Common Eider have been integrated into a simulation model (Gilliland *et al.* 2009), and the results suggest that the Greenland harvest of Northern Common Eiders is not sustainable, while the total Canadian harvest appears to be sustainable at current levels. In response, an International Eider Conservation and Management Plan were drafted by Canada and Greenland (Gilchrist *et al.* 2002).

The entire wintering range of Northern Common Eiders in Eastern Canada (and St. Pierre and Miquelon, France) was surveyed from fixed-wing aircraft in 2003, 2006 and 2009. Birds overwintering in the Gulf of St. Lawrence in 2003 and 2006

numbered 222 200 and 178 600, respectively (Bordage, Gilliland and Lepage, pers. comm.). Preliminary results for 2009 (visual estimates only, not corrected with photos yet) suggest a Canadian wintering population of 188 700 eiders.

As mentioned above, harvest information is estimated through the national harvest survey programs in Canada and the United States, and these estimates are thought to be imprecise for some sea duck species. This survey has shown that harvest of eiders has generally declined over the last 30 years; however, harvests in Newfoundland and Labrador have been increasing since 2005, and unusually high levels were recorded in 2007 and 2008. These levels have not been observed since the mid-1980s and may be unsustainable (Gilliland *et al.* 2009).

Although it is understood that some exploitation does occur in other areas, accurate estimates of winter and spring harvests on the north shore of the St. Lawrence are largely unknown. Inuit in Nunavut, Nunatsiavut and Nunavik harvest adults in spring, summer and fall, as well as eggs and down in summer. Inuit and non-Aboriginal people commercially harvest adults in winter in Greenland. Innu and non-Aboriginal people harvest adults in spring and winter in the Gulf of St. Lawrence. Understanding the dynamics of Northern Common Eider populations in the absence of more complete information on the harvest is somewhat problematic; efforts are currently underway to address this knowledge gap.

Hudson Bay Common Eider

The Hudson Bay subspecies of the Common Eider breeds within Hudson Bay and winters in open water leads near the Belcher Islands and off the western coast of Quebec. This is one of the only waterfowl species in the world that spends the entire year in Arctic waters. Mass die-offs can occur in winter when large proportions of the population are concentrated in open-water leads that sometimes freeze over (Robertson and Gilchrist 1998). The frequency and magnitude of these die-offs and the impact that they have on the Hudson Bay Common Eider population is unknown.

Breeding data for this subspecies only exist for the Belcher Islands and the area of LaPerouse Bay, Manitoba. The Belcher Islands, first surveyed in the 1980s, were resurveyed in 1997. The results showed that the breeding population had declined by 70% since the late 1980s, apparently due to winter weather events (e.g. freezing of polynyas) that led to high levels of mortality in 1992 (Robertson and Gilchrist 1998). The CWS initiated research into the winter ecology of Hudson Bay Common Eiders in 1998. The three winters that followed were mild, with vast expanses of open sea available to foraging flocks. There have been no significant winter kill events since this work began, and the eider population appears to be recovering.

American Common Eider

American Common Eiders are the most abundant species of sea duck breeding along the East Coast of North America. Their nests are sustainably exploited for down in the St. Lawrence estuary and birds are hunted throughout their breeding and wintering ranges.

In the Atlantic Region, based on surveys conducted in the last two decades, breeding population numbers are an estimated 18 000 pairs in Labrador, 3000 in Newfoundland, and 18 000 to 22 000 in Nova Scotia and New Brunswick (R. Milton, pers. comm.). The number of eiders breeding in northern Newfoundland has been increasing 9–12% per year throughout the 1990s (S. Gilliland, unpubl. data). There is also a significant number of eiders wintering around St. Pierre and Miquelon (France), where numbers increased over seven years of surveys, from about 2000 birds in 1994 to at least 12 000 birds in 2003 (B. Letournel, National Hunting and Wildlife Agency, France, pers. comm). In contrast to trends observed in Newfoundland and St. Pierre and Miquelon, preliminary analysis suggests eider breeding populations in New Brunswick may be experiencing a long-term decline in population size.

In the Quebec Region, there are more than 18 000 breeding pairs in the St. Lawrence estuary and about 19 000 in the Gulf of St. Lawrence (J.-F. Rail, CWS, unpubl. data). Trends in colony size are mostly stable in the estuary despite periodic fluctuations, and colony size is up by 10% per year since 1999 in the Gulf of St. Lawrence (Rail and Cotter 2005).

The eider (Common Eider and King Eider) harvest in Canada over the past five years (2004–2008) averaged 22 500 birds. The average number of eiders harvested in Quebec over this period is estimated at 2150 birds annually, while the average Nova Scotia harvest was an estimated 4800 birds. The largest harvest of Common Eiders in Canada takes place in Newfoundland, where it has been increasing over the past few years. The average number of eiders harvested in Newfoundland in 2008 was 14 180 (2004-2008) (Gendron and Collins 2009). The harvest of Common Eiders in the Atlantic Flyway over the four year period of 2006–2009 averaged 18 900 birds, with Maine and Massachusetts reporting the bulk (> 90%) of the U.S. harvest (Klimstra 2010). In recent years, with support from the Sea Duck Joint Venture, concerted banding efforts have been undertaken in the St. Lawrence estuary, in Newfoundland and Labrador, and in Maine to obtain a better estimate of harvest and

adult survival rates.

In the St. Lawrence estuary, eiderdown is harvested every year and parts of the profits are reinvested into conservation activities. During harvesting, the number of nests is counted which provides a yearly population estimate for the most important islands and contribute to the long-term monitoring of the population. Bédard *et al.* 2008 summarised eiderdown harvesting procedures.

Harlequin Duck

Until the 1990s, there was little knowledge of the ecology of Harlequin Ducks (*Histrionicus histrionicus*) in North America. However, research efforts have improved understanding of this species in some areas. Robertson and Goudie (1999) provide a review of available information on the Harlequin Duck.

Eastern Population

The eastern North American population of the Harlequin Duck was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered in Canada in 1990. As a consequence, hunting of this species was shut down throughout the Atlantic Flyway. In the late 1980s, the population overwintering in eastern North America was estimated at less than 1000 individuals (Goudie 1991). Overhunting, disturbance, and habitat loss are believed to have played a role in the decline of the population (Robertson and Goudie 1999). Later, new information indicating the number of harlequins breeding in Eastern Canada to be significantly larger than suspected led to the population being reassessed as a population of Special Concern (Thomas and Robert 2001).

Studies based on satellite telemetry suggested the existence of two Harlequin Duck populations: one that breeds in northern Quebec and Labrador and overwinters in southwest Greenland, and one that breeds in southern Labrador, Newfoundland, New Brunswick, and the Gaspé Peninsula of Quebec, and winters mostly in the Maritimes and Maine (Brodeur *et al.* 2002). Genetic studies support the existence of two populations with minimal gene flow (Scribner *et al.* 2000). The extent to which the breeding and wintering areas of these populations overlap is unknown. The size of the harlequin population that originates in Canada and overwinters in Greenland is also not known, but 6200 moulting harlequins were estimated along the western coast of Greenland during surveys in 1999 (Boertmann and Mosbech 2002). The population of Harlequin Ducks wintering in eastern North America is estimated at about 3000 birds, with slightly more than half (~1600) wintering in Maine at a single location (Mittelhauser 2008; Robertson and Goudie 1999; Thomas and Robert 2001). Numbers of Harlequin Ducks wintering in Eastern Canada have shown increases since the mid-1980s. Winter surveys conducted in 2010 identified approximately 300 birds in the Bay of Fundy, 600 on the southern and eastern coasts of Nova Scotia and roughly 450 Harlequin Ducks wintering in Newfoundland, This was encouraging news given the dramatic decline that occurred there through the 1980s and early 1990s.

Robertson *et al.* (2008) published a summary of the status of the eastern population of Harlequin Duck, and a document entitled "Management Plan for the Harlequin Duck (*Histrionicus histrionicus*), Eastern Population, in Atlantic Canada and Quebec" is available at: www.sararegistry.gc.ca/document/dspdocument_e.cfm?documentid=1276.

Western Population

Reflecting conservation concern for Harlequin Ducks, considerable attention has focused on western populations, particularly in the Strait of Georgia, over the past 15 years (S. Boyd and D. Esler, pers. comm.). Collaborative efforts by the CWS and Simon Fraser University have revealed much about the ecology and conservation of Harlequin Ducks; in fact, Harlequin Ducks in the Strait of Georgia are frequently highlighted as one of the sea ducks about which an unprecedented understanding of ecology and demography exists. In brief, findings include: (1) the Strait of Georgia provides non-breeding habitat for > 10 000 Harlequin Ducks, (2) concentrations in the Strait of Georgia during the spring herring spawn number in the thousands, which is a globally unique aggregation, (3) birds wintering in British Columbia breed across a wide range of mountain streams throughout the province and beyond, (4) they show very strong fidelity to wintering and moulting sites, which means that local aggregations are largely demographically discrete and therefore vulnerable to high harvest and/or disturbance levels as well as habitat change, (5) at least some ducklings follow their mothers to wintering areas, further contributing to the formation of distinct, independent population segments, (6) annual survival of adults appears to be high and sustainable, and (7) production of young birds appears to be sufficient to maintain stable population numbers (S. Boyd and D. Esler, pers. comm.).

Focused studies of Harlequin Ducks in the Strait of Georgia are coming to a close. We are completing an analysis of leg band data to determine survival rates and will publish the results. We also hope to re-establish field surveys of productivity, based on counts of male age ratios during winter to document annual variation and derive long-term means. Also, a research program was completed by the Centre for

Wildlife Ecology at Simon Fraser University to evaluate the roles of habitat quality and acquisition of nutrients for clutch formation (S. Boyd and D. Esler, pers. comm.).

Scoters

The three species of scoters that breed in Canada are Black Scoters (*Melanitta nigra*), Surf Scoters (*M. perspicillata*), and White-winged Scoters (*M. fusca*). Less is known about scoters than about any other group of sea ducks. Research efforts in recent years have brought us to a better understanding of the breeding, moulting and wintering ecology of this group. Bordage and Savard (1995), Brown and Fredrickson (1997) and Savard *et al.* (1998) all provide useful reviews of the information available on scoters. Several projects supported by the SDJV have also addressed research on important information gaps about scoters (www.seaduckjv.org/ssna.html).

Eastern Canada

Most Black Scoters breed in Eastern Canada, and until recently the eastern breeding ground was thought to be centred in Northern Quebec. However, recent satellite telemetry studies (2002-2004; 2009-2010) of migrating birds marked in spring in the Bay of Chaleur gives evidence that pairs also breed west of Quebec, i.e. in Northwestern Ontario, Northern Manitoba, Nunavut and the Northwest Territories east of Great Slave Lake (Gilliland and McAloney 2009). Western Black Scoters have a breeding ground centred in Alaska (Bordage and Savard 1995).

Surf Scoters are counted during the Eastern Waterfowl Survey, although the area surveyed (Figure 1) only partially covers the southern extent of the Surf Scoter breeding distribution. According to the Eastern Waterfowl Survey, Surf Scoters continue to do well in the boreal forest (Figure 22).

In 2008 and 2009, experimental helicopter surveys designed to survey breeding scoters were flown in Labrador in collaboration with the Institute for Environmental Monitoring and Research (Gilliland *et al.* 2008), and in Ontario in 2009 in collaboration with the Ontario Ministry of Natural Resources. Results indicated that the Surf Scoter was the most numerous species and that Black and White-winged scoters also bred there in smaller numbers.

The Bay of Chaleur area (Quebec and New Brunswick) as well as the St. Lawrence estuary and gulf are major spring staging areas for scoters. Aerial surveys that had been photo-corrected for observer error indicated an Atlantic Flyway spring staging population of about 90 000 Black Scoters, i.e. 52 000 in Bay of Chaleur and 36 300 in the St. Lawrence estuary (Quebec) in 2005 (K. McAloney, CWS, unpubl. data). In 1998, over 220 000 scoters (the three species) were staging in the St. Lawrence estuary and gulf (Rail and Savard 2003). Surf Scoters are the most numerous scoters in that region and are estimated to account for 70% of scoters.

Surveys in September and October 2006 indicated that the St. Lawrence Estuary was an important staging area for Surf Scoters in fall, since nearly 80 000 birds were counted there (J.-P. Savard, pers. comm.). Moult surveys in late July and early August of 2006 indicated that some 50 000 scoters (mostly male Surf and White-winged Scoters) moulted within the St. Lawrence estuary (J.-P. Savard, pers. comm.). Scoters (all three species) implanted with satellite transmitters also confirmed the importance of the Bay of Chaleur and the St. Lawrence Estuary and Gulf during spring migration, moulting and fall migration.

Between 50 000 and 62 000 moulting scoters (mostly male Surf Scoters) were sighted along the Labrador coast in 1998 and 1999 (S. Gilliland, pers. comm.).

A survey methodology development has been sponsored by the Sea Duck Joint Venture beginning a few years ago in order to survey moulting Black Scoters in James and Hudson bays. In 2006, the photo-corrected counts led to about 89 500 individuals. In 2009, further work was done to develop the survey methodology and the number of birds observed was about 111 000 (Cotter 2009; Ross *et al.* 2009). Further tests to the methodology in the coming years should eventually lead to reliable abundance indices for this species.

In August 2010, 20 White-winged Scoters were implanted with a satellite transmitter in the St. Lawrence estuary, where a few thousand birds moult each year. These implanted birds should provide valuable information on seasonal connectivity, timing and direction of movements, and site fidelity to wintering, breeding and moult sites (C. Lepage, pers. comm.).

Western Canada

The traditional survey area of the Waterfowl Breeding Population and Habitat Survey in Western Canada (Figure 6) covers a large part of the breeding area of White-winged Scoters, and a substantial portion of the Surf Scoter range. The three species of scoter are not differentiated during these surveys, however, as it is difficult to distinguish among them from fixed-winged aircraft. Based on the extent of known breeding distributions, scoter populations in the Canadian Prairies should be White-winged Scoters only, while populations in Western Boreal Canada include White-winged and Surf Scoters. All three species are present in Alaska. However, these data should be interpreted with

caution, as the surveys are not well designed for estimating scoter numbers (Savard *et* al. 1998).

Although found at very low densities on the Canadian Prairies, scoter numbers have declined over the long term based on the results of the Waterfowl Breeding Population and Habitat Survey (Figure 23). Surveys in 2010 indicated an estimated 1.17 million individuals in the entire survey area, which is a decrease of 5% from 2009 (Figure 23).

A more detailed examination of trends in various strata showed intriguing results. Alisauskas *et al.* (2004) showed that, contrary to the overall declining trend, scoters increased over the previous decade in northern Manitoba and Saskatchewan, but continued to decline in northern Alberta and the Northwest Territories. Their research, making use of reverse-time capture histories of White-winged Scoters at Redberry Lake, Saskatchewan, shows the long-term decline in the local population has now been arrested. Interestingly, this occurred as a result of increased recruitment through the immigration of adult females (Alisauskas *et al.* 2004).

Large concentrations of Surf Scoters and White-winged Scoters are found in coastal British Columbia, in habitats that also support shellfish aquaculture, an industry that has the potential to expand dramatically. Simon Fraser University and CWS have completed a study of the interactions between scoters and the shellfish industry, evaluating potential effects on scoter population sustainability at local and regional scales (S. Boyd and D. Esler, pers. comm.). The findings suggest that, at current levels of activity, the overall effect of the industry in one important area for both shellfish and scoters is sustainable (Baynes Sound). The project has resulted in the publication of several papers and two master's theses.

In response to the apparent decline in scoter numbers, reductions were made in 1993 to the bag limits for scoters in both the United States and Canada. The harvest of all three scoter species in Canada and the United States has declined considerably since the 1970s (Tables 9 to 11), although harvest levels of Surf scoters in the Atlantic Flyway in 2009 again appeared to be near historic levels. In Canada, the harvest is estimated at about 700 to 2000 birds of each species.

Barrow's Goldeneye

Eastern Population

In 2000, the small eastern population of Barrow's Goldeneye (*Bucephala islandica*) was assessed by COSEWIC as being of Special Concern. Because of the potential threat to the species, most Barrow's Goldeneye wintering and staging areas in Canada have been closed to hunting. However, because the Barrow's Goldeneye is an arboreal species, forestry operations and introduction of fish on fishless lakes on its breeding grounds are more likely to be threats (Robert *et al.* 2008).

The main breeding area of the eastern population of Barrow's Goldeneye consists of the small fishless lakes of the high plateaus north of the St. Lawrence River from the Saguenay River east to Blanc-Sablon, Quebec (Robert *et al.* 2000; Robert *et al.* 2008). In fact, high numbers of pairs and lone males detected in aerial and ground surveys indicate that this area is probably the core breeding area for the eastern population of the Barrow's Goldeneye (Robert *et al.* 2000).

In eastern North America, the only known moulting sites for adult male Barrow's Goldeneyes are located in the coastal waters of Hudson, Ungava, and Frobisher (Baffin Island) bays, and in a few coastal inlets of northern Labrador (Robert *et al.* 1999; Robert *et al.* 2002). Two moulting areas (Tasiujaq and Tuttutuuq River, Ungava Bay) were identified while tracking males with satellite telemetry in July 2000. At least 200 goldeneyes (mostly Barrow's) were at the first location, while at least 3000 goldeneyes (mostly Common) were in the latter area (M. Robert, pers. comm.). Barrow's Goldeneye spent up to four months in the moulting locations, highlighting the importance of these areas in the annual cycle (Robert *et al.* 2002).

Since 2005, a triennial winter survey has been conducted in Quebec and New Brunswick. The 2009 results indicated that the eastern North American wintering population of Barrow's Goldeneyes was composed of 6800 individuals, of which > 80% winter along the St. Lawrence estuary and gulf (CWS unpubl. data). About 500 individuals winter in the Atlantic provinces and 100 individuals in Maine (Robert and Savard 2006; CWS, unpubl. data).

Results of Christmas Bird Counts from Tadoussac suggest a slight increase in Barrow's Goldeneye numbers in the last decade (Savard 2008).

Western Population

There are no accurate population estimates or trends for the western population of Barrow's Goldeneye. Some short-term data are available for this population from the breeding waterfowl surveys of the southern Yukon (figure 24). In the southern Yukon Territory in 2010 the breeding population shows no trend over the past 5, 10 and 15 years (Figure 24).

Barrow's Goldeneye and Bufflehead research undertaken in central B.C. from 1997 to 2001 found Barrow's Goldeneye nests located primarily in abandoned Pileated Woodpecker cavities located in large Aspen trees (Evans 2003). Over 90% of all cavities were within 200 metres of a body of water. Barrow's Goldeneyes appear to select more

productive wetlands, and invertebrate abundance within a wetland was positively correlated with duckling masses at day 40, pre-fledging survival and first-year return rates.

Moulting female Barrow's Goldeneyes have been banded annually since 1988 in central B.C., in an area where the breeding population has also been banded. Survey and recapture data indicate that Barrow's females do not moult locally (with or without their broods) and that they can aggregate into small groups for the wing moult (A. Breault, pers. comm.). The differences in composition between the breeding and moulting populations indicate that central B.C. experiences two different moult migrations: the local breeders depart for an unknown destination, while birds of unknown origin come in and replace local breeders on breeding ponds. The geographic extent of the female Barrow's Goldeneye moult and the number of females involved is being investigated through satellite telemetry (see below).

From 2006 to 2008, W.S. Boyd (Environment Canada, Science and Technology Branch) and D. Esler (Simon Fraser University – Centre for Wildlife Ecology) have satellite-tagged all age and sex classes of Barrow's Goldeneye at a study site in the interior of B.C. (Riske Creek). All males marked in May 2006, 2007 and 2008 migrated north to northern Alberta and Northwest Territories to moult, and many are showing high site-fidelity to both moulting and wintering sites, and an especially strong connection with a moulting/staging site in Alberta, Cardinal Lake. Some hens and hatch year birds marked in July 2008 and 2009 are still being tracked. Maps showing movement and location data for all marked birds are available at: www.sfu.ca/biology/wildberg/CWESeaducksfolder/BAGOwebpage/BAGOMigrationHome.html. The satellite data will be used to determine migration routes, site fidelity, and affiliations between breeding, moulting, staging and wintering sites. The data will also be used to further our understanding of population structure for Pacific Barrow's Goldeneye.

Other Sea Ducks

Information on other sea duck species from the Waterfowl Breeding Population and Habitat Survey in Western Canada and the Eastern Waterfowl Survey is presented in Table 3 and Figure 22 respectively. Information on western Barrow's Goldeneye and Bufflehead from the roadside surveys in the Yukon is presented in Figure 24.

The Waterfowl Breeding Population and Habitat Survey in Western Canada shows significant increases in numbers of mergansers, goldeneyes and Buffleheads over the long term, but a declining trend for Long-tailed Ducks (Table 3). For the period 1990–2003, the Eastern Waterfowl Survey showed significant increases in numbers of Surf Scoter (8.0% per year), Common Goldeneye (3%) and Hooded Merganser (4.3%), and a significant decrease of Bufflehead (8.9%) (CWS, unpubl. data). Since then, the numbers of Bufflehead have gone up while Surf Scoter and Common Goldeneye have declined and Hooded Merganser has stabilized (Figure 22).

Growth Rates in North American Goose Populations

(Kathryn Dickson, CWS, National Office – reprinted from CWS Migratory Birds Regulatory Report Number 30, July 2010)

Populations of many North American goose species have been growing rapidly over recent decades. This pattern has been well-described for mid-continent Lesser Snow Geese *(Chen caerulescens caerulescens)* and Greater Snow Geese (*Chen caerulescens atlantica*) (Batt 1997, 1998), two populations which in 1999 were designated to be overabundant. In this case, the populations had become so large that unsustainable levels of foraging were adversely affecting key habitats for migratory birds and other wildlife. Left unchecked, overabundant snow goose populations were judged likely to become seriously injurious to their own long-term survival and to that of other migratory birds, compromising the biological diversity of the Arctic ecosystem. The overabundance designation meant that the responsible agencies in Canada and the United States have been able to work at controlling the goose numbers by using extraordinary means to encourage hunters to increase their harvest to two or three times the previous level (see section of this report, entitled, "Management of Overabundant Snow Geese").

The rapid growth of the snow goose populations is explained by three key factors. First among these is the steady increase in quantity and quality of foods available on the migration areas and wintering grounds over recent decades, to the point where food resources over winter and during migration are no longer limiting. The increase in food availability is described in detail in Jefferies *et al.* (2003), who discuss the evolution of rice cultivation in the southern United States, the spread of corn fields with their spilled grains and the increasing yields brought about through use of more and better fertilizers. Geese have adapted to this altered landscape by increasing their feeding in agricultural fields and reducing their use of natural marshes. This behaviour has allowed them to better survive over winter, return to the breeding grounds in better condition, and thus, produce more young (Abraham *et al.* 1996). Secondly, the establishment of refugia (such as National Wildlife Refuges in the USA,

National Wildlife Areas in Canada, sanctuaries, etc.) and thirdly, increases in population size have outpaced increases in harvest, resulting in lower harvest rates, which in turn have contributed to the high survival rates now enjoyed by snow geese (Abraham *et al.* 1996).

In addition to the factors listed above, climate change is likely affecting goose populations, particularly those that breed in the Arctic where the production of young is heavily dependent on the weather conditions. Production is highest when the snow melts early and temperatures are relatively mild through the periods of brood-rearing and fledging. In very cold years with a delayed spring, geese may forgo nesting altogether. For example, the Lesser Snow Goose population nesting on Wrangel Island, Russia, was reduced by two thirds in the 1970s as a result of four consecutive late springs, while the same population has more than doubled in recent years because of relatively good weather and associated high annual recruitment (S. Boyd, pers. comm.). The Arctic is warming due to climate change and this will likely lead to higher productivity levels, and hence population growth rates, for this and other goose populations in the future. Alternatively, there is recent evidence from Alaska to suggest that climate change would affect the species composition of the plant community, resulting in greater biomass but poorer quality foods for geese (Schmutz *et al.* 2008) which could have negative effects on survival and productivity.

It is not surprising that several goose species are benefitting from the increase in resources provided by the agricultural landscape. High population growth rates have also been estimated for Lesser Snow Geese of the Canada's Western Arctic, Ross's Geese (*Chen rossii*) and temperate–breeding Canada Geese (*Branta canadensis*). In the latter case, not only has the agricultural landscape provided higher quality foods; the conversion of forests to open agricultural lands and even to urban lands, particularly those close to water, has created safe nesting and brood-rearing sites (Hughes 2009). However, as Van Eerden *et al.* (1996) stated, the increased dependence of waterfowl on agricultural food tends also to lead to increasing numbers of conflicts with people, and damage to property and crops.

The pattern of landscape change over the past couple of centuries in North America parallels that observed in Europe, where the clearing of forests and draining of wetlands to produce cultivated lands began to intensify as early as A.D. 1000 (Van Eerden *et al.* 1996). The widespread application of nitrogen-based fertilizers increased plant production and extended the growing season (Van Eerden *et al.*, 1996) so that the habit of geese feeding on improved pastures and crops became established in the Netherlands by A.D. 1400, and once established, the tradition of feeding on certain food appears to be maintained in the population. The authors' review concluded that all goose species (and two species of swans) now rely heavily (at least five months per year) on agricultural lands for overwintering in the Netherlands: Greylag Goose (*Anser anser*), Bean Goose (*Anser fabalis*), White-fronted Goose (*Anser albifrons*), Pink-footed Goose (*Anser brachyrhynchus*), Barnacle Goose (*Branta leucopsis*) and Brant Goose (*Branta bernicla*). Moreover, all species increased in abundance between the 1960s and 1990s (Van Eerden *et al.* 1996). The increases in abundance are due to the favourable landscape conditions as well as to a significant reduction in harvest mortality which took place during the same period (Van Eerden *et al.* 1996).

In contrast to the situation in northern Europe where the abundance of all goose species has responded positively to landscape changes by capitalizing on agricultural food availability, some North American species have not reaped the benefits. For example, neither subspecies of Brant (*Branta bernicla hrota* and *Branta bernicla nigricans*) has begun using agricultural landscapes to any great extent, and for the most part remain restricted to natural marshes. Their relatively small populations as estimated during winter surveys appear to be rather stable (CWS Waterfowl Committee, November Report 2010). In addition, hunters continue to harvest Brant at relatively high harvest rates controlled under management plans (e.g. Atlantic Flyway Council 2002).

It might be expected that Cackling Geese (*Branta hutchinsii*) would also capitalize on the present agricultural landscape. This species occupies much of the same breeding, migration and wintering area as Lesser Snow Geese but has not shown the same increase in abundance and appears to be held in check by sufficiently high harvest rates. However, the quality of abundance estimates for this species is poor.

Until recently, the abundance of Mid-continent Greater White-fronted Geese (*Anser albifrons*) followed a pattern of continued increase. Based on winter counts, the population increased dramatically from 12 000 in the 1950s to 140 000 in 1995 (Abraham and Jefferies 1997). Recognizing that its numbers were likely underestimated, and that it might more accurately be counted on the fall staging area, a new survey was initiated in 1992 in southern Saskatchewan and Alberta (Nieman and Gollop 1993). Since then, that survey has shown a fluctuating but stable population of between 600 000 and 1 million birds. In 2010, the estimated population was over 700 000 birds (K. Warner, pers. comm.).

Why has the population of White-fronted Geese recently stopped growing? This too, appears related to more recent changes in the agricultural landscape. Recent evidence produced by Pearse *et al.* (submitted) reported that in the late 1990s the geese had greatly reduced the accumulation of fats on the key spring staging area in Nebraska, in comparison to the late 1970s. This is because much less corn is now grown in that area (Krapu *et al.* 2004). Instead, the birds now spend several weeks in southern Saskatchewan feeding on pulse crops, which Pearse *et al.* (submitted) showed did not make up the deficit in fat storage. This deficit could reduce the subsequent reproductive success; age ratios in the harvest are now much lower than they were formerly (D. Nieman pers. comm.). Pearse *et al.* (submitted) also suggested other factors potentially related to this shift in spring staging distribution, such as an earlier migration schedule and increased competition with Lesser Snow Geese staging in Nebraska.

In addition, the tight family bonds of White-fronted Geese render the species relatively easy to decoy and so remain very susceptible to hunting mortality. Alisauskas *et al.* (2009) estimated adult harvest rates through 2004 for White-fronted Geese to be about twice those estimated for Lesser Snow Geese or Ross's Geese, and about the same as for Greater Snow Geese. Continued high harvest rates and reduced production may be preventing White-fronted Geese from increasing rapidly.

In general the goose populations of North America are strongly influenced by the distribution and quality of winter foods. The present quantity of high-quality food is contributing to the rapid increase in abundance of several populations, in some cases beyond desirable limits. Whether or not special management actions will be required in future to reduce damage and conflicts is not known. As indicated by Garrott *et al.* (1993) there is certainly a need to work diligently to stop the declines of rare species, but we must also act to address conservation issues that concern common and overabundant species. Furthermore, acting to address overabundance is sometimes required despite the unpopular fact that it may be necessary to remove animals. Our experience with snow geese suggests that we need to carefully monitor the abundance of North American goose populations and implement prescriptions before they increase beyond our ability to manage and control.

Population Status of Geese

Snow Goose

Greater Snow Goose

Greater Snow Geese (*Chen caerulescens atlanticus*) breed in the eastern Arctic around northern Foxe Basin, northern Baffin, Bylot, Axel Heiberg and Ellesmere islands, and northern Greenland. They winter along the mid-Atlantic coast from New Jersey to North Carolina. During migration, the entire population stages in southern Quebec in the marshes and agricultural lands.

The growth of the Greater Snow Goose population from a few thousand birds in the 1930s to over 500 000 in spring in the early 1990s has been well documented (Reed *et al.* 1998a). Aerial surveys of the main staging area in southern Quebec have been conducted every spring since 1965. Five aircraft are used simultaneously during a one-day survey effort to further increase coverage and limit survey flight duration to the mid-day period. Following the 2009 results, which showed a large population increase that was difficult to explain biologically, the Service de Consultation Statistique (SCS) from Laval University was hired to verify the sampling and analysis methodology. During this process, some gaps were found which resulted in some corrections for the 2010 spring survey. Thus, in 2010 the size of the spring population during staging in the St. Lawrence River Valley was estimated at 814 000 ± 77 000 geese (Figure 25; Lefebvre 2010). Based on SCS recommendations, a revision process has been undertaken to check last year's estimates to verify their accuracy. Special conservation measures were implemented in 1999 to slow or reduce the rapid growth rate of the population.

A detailed study of the reproductive ecology of Greater Snow Geese at the Bylot Island breeding colony continued in 2010. Breeding conditions for Greater Snow Geese were near average in 2010 on Bylot Island. There was a very deep snow-pack in early spring, one of the deepest on record. However, the weather in late May and early June was very mild with little precipitation; thus, even though the snow melted fast, the melt was still later than normal. Weather was warm and sunny throughout most of June and early July. Nesting phenology was variable between sites but overall near normal; clutch size was higher than normal, probably because partial predation on nests was low this year. Indeed, most predators switched to lemmings due to their great abundance, resulting in high nesting success this year. The abundance of lemmings also meant that a large number of Snowy Owls nested on Bylot Island

in 2010. Based on preliminary results, the median peak laying date of the first egg was 14 June, which is two days later than the long-term average (June 12). However, for the many geese nesting near Snowy Owls, median peak laying date was four days earlier. In 2010, mean clutch size was 4.2 eggs/nest compared to the long-term average of 3.71. The Bylot research team banded over 4267 geese in 2010. The ratio of goslings to adults among geese captured was 1.18, which is slightly higher than the long-term average of 1.03. Based on this gosling:adult ratio, the proportion of young in the fall flight is predicted to be 28%, well above the long-term average of around 22% (G. Gauthier, pers. comm.). Nevertheless, it must be remembered that Bylot Island is only one of many Greater Snow Goose nesting colonies in the eastern Arctic and conditions may vary among sites. Poor conditions at other sites could result in a lower proportion of young than predicted.

In Canada, the 2009 fall goose harvest was estimated at 51 543 (Table 12), well below the harvest in 2008 (120 666) and below the five-year average (78 679). In the U.S., the harvest was estimated at about 29 426 birds, which was below average for the most recent five-year period (41 938).

An estimated 20 628 ± 2723 birds were harvested during the special conservation measures in spring 2010 in Canada (Collins and Zimmerling 2010). Numbers harvested were below the 2009 estimate (decrease of 24%), and were the lowest ever recorded since the conservation measures were first introduced in 1999 (44 171; Figure 26).

In 2009 for the first time, special conservation measures for Greater Snow Geese were also put in place in six U.S. states of the Atlantic Flyway. In spring 2010, the estimated total harvest of 47 771 birds was more than double the estimated harvest in the first year of implementation of the special conservation season in 2009 (24 853; Snow Goose, Brant and Swan Committee, July 2010).

Lesser Snow Goose

Lesser Snow Geese (*Chen caerulescens caerulescens*) nest in colonies throughout much of the coastal areas of the Canadian Arctic. These colonies can be grouped according to three regions: the eastern Arctic (Southampton and Baffin islands, and the western and southern shores of Hudson Bay), the central Arctic (mainland from Coppermine in the west to Gjoa Haven in the east, and western Victoria Island), and the western Arctic (Banks Island, and the Anderson and Mackenzie River deltas).

Breeding ground surveys have shown substantial growth of Lesser Snow Goose populations at several colonies and the establishment of new colonies in recent years (Batt 1998). The CWS is coordinating a series of photographic inventories of major Lesser Snow Goose nesting colonies, and these results are reported below.

The increasing number of Lesser Snow Geese in the eastern and central Arctic is also indexed by surveys on wintering areas throughout the late 1990s. It should be noted that these geese are also referred to as the Mid-continent Lesser Snow Geese. Mid-winter counts increased from 0.78 million geese in 1970 to nearly 3.0 million in 1998 (Kruse 2007; Figure 27). The 2010 mid-winter count was about 2.7 million geese (USFWS 2010). These counts include some Ross's Geese and probably a small proportion of Lesser Snow Geese originating in western Arctic colonies. However, mid-winter counts underestimate actual population levels, and probably increasingly so, as populations have grown (Mowbray *et al.* 2000).

The midcontinent population of Lesser Snow Geese likely exceeded 15 million adult birds in 2010, and some estimates suggest that the population could be even larger than that (Alisauskas *et al.*, in press).

Eastern Arctic Colonies

Between 2003 and 2005 photographic inventories of the largest Lesser Snow Goose nesting colonies in the eastern Arctic were conducted, for comparison to earlier counts in the early 1970s and in 1997. When the Great Plain of the Koukdjuak (on Baffin Island) and Southampton Island were first surveyed in 1973, there were only 446 600 and 155 800 nesting birds, respectively (Kerbes 1975), and the area where nests were found was much smaller. By 1997, those colonies had grown to 1.7 and 0.7 million nesting birds, respectively (Figure 28). Estimates of nesting snow geese on Southampton Island in 2004 suggested numbers similar to 1997, whereas those estimated on Baffin Island in 2005 indicated the population may have declined slightly (Figure 28).

At West Hudson Bay, snow goose numbers declined by about half between 1985 and 1997, when they numbered just over 200 000 geese (Figure 28). Estimates from photo surveys conducted in 2003 suggest that the nesting population increased slightly between 1997 and 2003, but that most of the increase occurred north of the traditional nesting colony centred at the McConnell River and especially to the north of Arviat, Nunavut.

In the Hudson Bay lowlands, surveys conducted between 1996 and 2003 showed the number of nesting pairs to be declining from the peak in 1997, when 430 000 birds were estimated nesting in the area between La Pérouse Bay, Manitoba, and Cape Henrietta Maria, Ontario (K. Ross and K. Abraham, pers. comm.). The 2006 survey of the La Pérouse

Bay colony yielded 41 800 breeding pairs, virtually the same number as in 1997 (i.e. 41 700 pairs); the two small colonies near Thompson Point held 1700 and 5400 pairs, respectively (K. Abraham, R. Rockwell and K. Ross, pers. comm.). The Cape Henrietta Maria colony contained an estimated 129 000 nesting pairs in mid-incubation in 2001, and 128 000 pairs in 2003. These data represent a considerable increase from 1979, when the nesting population was estimated at 55 000 nesting pairs (P. Anghern, unpubl. report). In 2005, a survey was conducted at Cape Henrietta Maria in June and the extent and density of the colony appeared similar to 2001 and 2003 (K. Abraham and K. Ross, pers. comm.). Nesting pair surveys were also conducted in early June at West Pen Island and Shell Brook colonies on the Hudson Bay coast. The West Pen Island colony had high densities in an occupied area similar to the 1997 survey, when approximately 8500 pairs were estimated. However, the area occupied and the number of pairs estimated in 2005 at Shell Brook was greatly reduced from the 1997 estimate of 2700 pairs (K. Abraham and K. Ross, pers. comm.).

At James Bay, the small Akimiski Island colony (Abraham *et al.* 1999a) was also surveyed. Between 1998 and 2000, the colony consistently had an estimated 900 breeding pairs (K. Abraham, pers. comm.), increasing to about 1500 pairs in 2001 and remaining about the same in 2003.

Overall, spring phenology was early across much of the eastern Arctic in 2010, and production of Lesser Snow Geese was expected to be average or above average at all major colonies.

Central Arctic Colonies

The central Arctic breeding population, concentrated in the Queen Maud Gulf, grew more slowly than the eastern population before the 1980s, but now appears to be increasing rapidly. Part of the rapid growth may be due to the immigration of eastern Arctic birds. In 1976, there were 30 colonies with nearly 56 000 nesting Lesser Snow Geese. By 1988, the number of colonies had increased to 57, with about 280 000 nesting Lesser Snow Geese (Kerbes 1996). Information from a photographic inventory conducted in 1998 indicated that the snow goose population was in excess of 700 000 scattered over 80 colonies (R. Kerbes, unpubl. data). This suggests that the population had more than doubled since the last photographic inventory (Figure 28).

At Karrak Lake in the Queen Maud Gulf, the area used by nesting Ross's Geese and Lesser Snow Geese has been increasing exponentially. In 2004 the area of terrestrial habitat occupied by nesting geese at Karrak Lake increased from 177 km^2 to 201 km^2. However, the nesting area did not change in 2005 (198 km^2). Similarly, at the East McNaughton colony of light geese, about 90 km east of Karrak Lake, the area of terrestrial habitat occupied by nesting geese increased from 214 km^2 to 230 km^2 (R. Alisauskas, pers. comm.). Based on general impressions of conditions in the central Canadian Arctic, timing of nesting took place later than average at Karrak Lake in 2010. This makes 2010 the fourth year in a row where nesting phenology was later than average (R. Alisauskas, pers. comm.).

Western Arctic Colonies

More than 95% of Lesser Snow Geese in the western Canadian Arctic nest on Banks Island. This population increased substantially between the 1960s and 2002. The total nesting population increased, growing from around 105 000 birds in 1960 to 165 000 in 1976, and exceeding 479 000 in 1995 (Kerbes *et al.* 1999). Photographic inventories of the colony indicate that the number of nesting birds on Banks Island has declined dramatically between 2002 and 2007 from 570 000 to 300 0000 geese (C. Wood, pers. comm.). Preliminary results from the 2009 survey indicate more than 400 000 geese were present in the colony, suggesting that the low numbers seen in 2007 were likely an artefact of a poor breeding season that year (M. Robertson, pers. comm.).

The remaining western Arctic snow geese nest at small mainland colonies on the Anderson River and Kendall Island Migratory Bird Sanctuaries. The mainland populations have varied in size from year to year (Kendall Island) or declined (Anderson River) during the last decade.

Lesser Snow Geese nesting on Wrangel Island, Russia, are also of great interest to Canada, because this population migrates through Western Canada in fall and spring, and more than half of the population winters on the Fraser Delta (B.C.) and the nearby Skagit Delta (Washington). The present colony of Lesser Snow Geese on Wrangel Island is all that remains of the large colonies that existed in Siberia a century ago. Russian biologists monitoring the population have documented a decline from 120 000 nesting birds in 1970 (total population of 150 000 geese) to fewer than half that number in the 1990s (total population of 60 000–70 000 geese) (Kerbes *et al.* 1999). The total population has increased in recent years to 150 000–160 000 birds (S. Boyd, pers. comm.). Baranyuk (Wrangel Island Reserve, Russia, pers. comm.) reported the 2010 spring breeding population of Wrangel Island snow geese in the range of 130 000 to 140 000 birds, similar to last year's estimate. Breeding conditions were poor in 2010; a late spring resulted in few goslings being produced and a preliminary estimate of < 10% (and possibly < 5%) young in the fall population (S. Boyd, pers. comm.).

The Fraser-Skagit winter population in British Columbia has roughly doubled since the early 1990s,

increasing to 102 000 birds in 2006–2007, the highest abundance ever recorded. Recent increases in harvest rates and reductions in recruitment rates have caused the population to decline to 75 000 birds in 2009-2010. The 2010-2011 population is predicted to be ca. 65 000-70 000 birds. Once the winter population increased above ca. 60 000 birds in the early 2000s, increased conflicts (socio-economic) occurred with local farms, schools and the Vancouver International Airport on the Fraser River delta. In addition, increased grubbing rates resulted in a severe reduction in bulrush biomass. Data from a long-term monitoring program suggest that the marsh will move to a state of "functional extinction" if the goose population remains above 60 000 individuals (S. Boyd, pers. comm.). To help alleviate the above concerns, responsible management agencies in British Columbia and Washington implemented amendments to hunting regulations in 2003–2004 and again in 2007–2008 to reduce the number of geese. A harvest strategy is currently being developed to maintain the winter population within acceptable limits so that the marsh habitat remains at a healthy, sustainable level and socio-economic concerns are minimized. The intent is to make hunting regulations, and hence harvest rates, responsive to goose abundance. For a variety of reasons, the large majority of this harvest will occur on the Skagit River delta in Washington State.

Harvest of Lesser Snow Geese

In the United States, Lesser Snow Geese are harvested in all four flyways, but mostly in the Mississippi and Central flyways. In 2009, the total U.S. harvest estimate was 312 115 geese, a decrease of 37% compared to 2008 (Table 13). In Canada, the estimated harvest was 103 846 birds in 2009, a decrease of 34% compared to 2008.

Since 1990, CWS Pacific and Yukon Region has conducted a special annual harvest survey of Lesser Snow Geese from the Wrangel Island population. Prior to 2003, harvest estimates varied from a low of 623 in 1990 to a high of 1989 in 2003 (A. Breault, unpubl. data; Figure 29). The 2009-2010 harvest was estimated at 4568 birds, a substantial increase from the 1426 birds harvested the previous year (when unseasonal below-freezing temperatures and ground-level snow occurred from early November to mid-January, limiting movements and availability of snow geese to local hunters). Harvest figures include a +20% adjustment for crippling loss (A. Breault, pers. comm.).

Management of Overabundant Snow Geese

(adapted from CWS Migratory Birds Regulatory Report Number 30, July 2010)

Issue

The rapid growth of most snow goose populations is of great concern. A decade ago, comprehensive assessments of the environmental effects of the rapidly growing populations of mid-continent Lesser Snow Geese and Greater Snow Geese were completed by working groups of Canadian and American scientists. Their analyses are contained in the reports entitled *Arctic Ecosystems in Peril – Report of the Arctic Goose Habitat Working Group* (Batt 1997) and *The Greater Snow Goose – Report of the Arctic Goose Habitat Working Group* (Batt 1998). These working groups concluded that the increase in snow goose populations was primarily human induced. Improved farming practices supplying a steady food source along with the safety of refuges have resulted in increased survival and reproductive rates in snow seese. These populations have become so large that they are affecting the plant communities at staging areas and breeding grounds on which they and other species rely. Grazing and grubbing by geese not only permanently removes vegetation, but also changes soil salinity, nitrogen dynamics and moisture levels. The result is the alteration or elimination of the plant communities, which in all likelihood will not be restored. Although the Arctic is vast, the areas that support migrating and breeding geese and other companion species are limited in extent and some areas are likely to become inhospitable for decades. Increasing crop damage is also an important consequence of the growing snow goose populations.

Increasing numbers of spring migrant Greater Snow Geese have been observed in recent years at the western edge of the spring staging range on agricultural lands of eastern Ontario. CWS, in concert with the Ontario Ministry of Natural Resources, is examining the possibility of establishing special conservation measures for snow geese in eastern Ontario beginning in spring 2012 to assist efforts already in place in Quebec to curtail the rapid population growth and reduce the population size of Greater Snow Geese.

A similar situation has been observed in recent years on the tidal marsh habitats in and around Restigouche County, New Brunswick. CWS, in concert with the New Brunswick Department of Natural Resources, examined the possibility of establishing special conservation measures in New Brunswick and has decided not to proceed at this time.

Regulation

Several concurrent management measures are

being undertaken to curtail the rapid population growth and reduce population size to a level consistent with the carrying capacity of the habitat. One measure attempts to increase the mortality rate of snow geese by two to three times the rate achieved prior to the introduction of special conservation measures. Beginning in 1999, an amendment to the *Migratory Birds Regulations* created special conditions under which hunters were encouraged to take overabundant species for conservation reasons and, in some cases and subject to specific controls, to use exceptional methods and equipment such as electronic calls and bait. The 1999 and 2000 regulations applied in selected areas of Quebec and Manitoba. Beginning in spring 2001, special conservation measures were also implemented in Saskatchewan and Nunavut. The dates and locations of application of these special conservation measures were determined in consultation with the provincial governments, other organizations and local communities.

Evaluation

Scientific studies are being implemented to track progress toward the goals of reduced population growth and, ultimately, recovery by plant communities.

For Lesser Snow Geese, the original objectives were to increase the continental harvest to approximately 0.8 to 1.2 million birds annually (Rockwell *et al.* 1997). These projections were later challenged as being too conservative, and annual harvest requirements of 1.4 to 3.4 million birds were projected on the basis of updated information (Cooke *et al.* 2000; Rockwell and Ankney 2000).

An evaluation of the effectiveness of the special measures for mid-continent Lesser Snow Geese is being finalized. Overall, the balance of evidence favoured the conclusion that the midcontinent population has not declined as a result of the conservation measure, but instead has continued to grow, although perhaps at a reduced rate (Alisauskas *et al.*, in press). The authors concluded that the weighted survival probability for midcontinent snow geese essentially did not change between the period preceding the conservation measures (1989–1997) and during the conservation measures themselves (1998–2006). They estimated low harvest rates which increased from 0.024 during 1989–1997 for the most northern of the Arctic colonies geese to only 0.027 during 1998–2006, and from 0.031 to only 0.037 for the more southern arctic colonies. Alisauskas *et al.* (in press) concluded that the annual harvest did increase as a result of the conservation measures but failed to exceed 1 million adults in any year during the assessment period from 1989 to 2006.

In the case of Greater Snow Geese, the population objective adopted by the North American Waterfowl Management Plan is 500 000 birds, or about one-half of the nearly 1.0 million birds present in 1999. A recent evaluation demonstrated that special measures (for which the spring season was key) were successful in reducing the annual survival rate for adults from about 83% to about 72.5% (Calvert *et al.* 2007). This was reflected in the spring counts, which until recently indicated that the population had stabilized at about 1 million birds; however, in 2009 the estimate leapt to 1.4 million birds. In 2010 the population was estimated at 814 000 geese (Lefebvre 2010).

Models show that without a spring harvest, the population would quickly begin to grow rapidly once more (Gauthier and Reed 2007) as a result of climatic changes that favour good breeding conditions in the Arctic as well as improved feeding conditions (corn and other crops) on wintering and staging grounds. At the same time, it appears that the harvest in Canada has been maximized. Beginning in 2009 the eastern United States were permitted to harvest additional Greater Snow Geese under a special Conservation Order. A report of the Snow Goose, Brant and Swan Committee (July 2010) of the Atlantic Flyway Council indicated that the estimated harvest of 47 771 birds for spring 2010 was more than twice the size of the estimate for the first year (i.e. 24 853 birds in 2009). Whether this additional harvest pressure will be sufficient to bring the population under control remains to be seen.

Canada's strategic plan for the 2005–2010 period lays out key directions for management of Greater Snow Geese (Bélanger and Lefebvre 2006). Among these are the following: maintain a good quality long-term survey to estimate the size of the continental population; monitor the response of the population to management measures; achieve the necessary harvest rates in Quebec; work with the U.S. Fish and Wildlife Service and state governments toward increasing the harvest of Greater Snow Geese on wintering grounds in the United States; maintain good quality breeding and staging habitats in Quebec; maximize bird watching and hunting opportunities; and review crop damage prevention and compensation programs.

Regulation for 2011–2012

The special measures to be implemented in spring 2011 are posted on the CWS website:
www.ec.gc.ca/rcom-mbhr/default.asp?lang=en&n=a297b56f-1
and are shown in Appendix A of this report.

Ross's Goose

About 95% of all Ross's Geese (*Chen rossii*) nest in the Queen Maud Gulf area of the central

Canadian Arctic. Increasing numbers are being found along the western coast of Hudson Bay, on Baffin, Southampton, and Banks islands, at La Perouse Bay, Manitoba, and Cape Henrietta Maria, Ontario (Kerbes 1994; D. Caswell, pers. comm.; K. Abraham, pers. comm.). Nesting colonies of Ross's Goose are usually interspersed with those of Lesser Snow Geese, so it is difficult to accurately evaluate the size of Ross's Goose populations. Ross's Geese winter in California, New Mexico, Texas and Mexico.

Ross's Goose was considered a rare species in the early 1900s. When legislation was passed to prohibit hunting in 1931, the estimated population of Ross's Goose was only 5000 to 6000 birds. By 1988, the breeding population had increased to more than 188 000 birds in the Queen Maud Gulf Migratory Bird Sanctuary (Kerbes 1994; Ryder and Alisauskas 1995) and to about 982 000 in 1998 (Alisauskas *et al.* 1998). Helicopter surveys on Baffin Island, in conjunction with the banding in August, indicated that there may be more than 10 000 Ross's Geese present in some years (D. Caswell, pers. comm.). A new colony of nesting Ross's Geese became established near the McConnell River, Nunavut, in the early 1990s, and was estimated at more than 70 000 birds in 2003. The colony continued to increase and was estimated at about 90 000 nesting birds in 2005 (J. Caswell, pers. comm.). Information gathered while banding Lesser Snow Geese near Cape Henrietta Maria, Ontario, indicated that the Ross's Goose population there may now be as large as 2250 pairs (Abraham 2002). The largest colony of Ross's Goose is found near Karrak Lake in the Queen Maud Gulf, where an estimated 479 400 birds nested in 2001 (Alisauskas 2001).

A recent analysis by Alisauskas *et al.* (2006) described changes in the geographic distribution of Ross's Geese in winter. Over the past decade the wintering populations, and the harvest, have shifted eastward, matching the eastward expansion of the breeding populations. These authors also found that the continental harvest of Ross's Geese began to grow some time around 1994, when the normal hunting seasons were made more liberal. Prior to 1994, the survival rate for adults was at least 0.91, but since then numbers have declined to about 0.80. Alisauskas *et al.* (2006) concluded that at the current rate of annual survival, the Ross's Goose population should, at a minimum, remain stable or even continue to grow.

A late spring in much of the central Arctic region of Canada likely resulted in the fourth straight year of below-average production for Ross's Geese. However, conditions were more favourable in most of the eastern Arctic, where anecdotal evidence suggests that Ross's Goose numbers continue to grow.

Greater White-fronted Goose

In the past, Greater White-fronted Goose (*Anser albifrons*) surveys were conducted in early spring, but these counts were problematic when geese were too widely spread along their migration route to allow for good counts. As numbers of Mid-continent Lesser Snow Geese increased in the important count areas, the surveys became even more problematic; they were abandoned in 1992. However, until the early to mid-1980s, the surveys did a good job of tracking the trend in Greater White-fronted Goose numbers, indicating that the overall population grew from the late 1950s to the early 1980s (J. Hines, pers. comm.).

In 1992, a fall survey of the staging areas in Saskatchewan and Alberta was implemented with the objective of providing an annual index of the population size of Mid-continent Greater White-fronted Geese. Because it is unlikely that significant numbers of geese are present outside the survey area in most years (based on historical migration and distribution data, as well as experimental surveys), this fall inventory accounts for a consistent and significant proportion of the population (Nieman *et al.* 2001). Preliminary results for fall 2010 indicate a total of 709 800 geese, which represents a 22% increase over 2009 and a 3% decrease in the three-year average. The current three-year average is 681 567 (Figure 30) (Warner *et al.*, in prep.).

Banding of Mid-continent White-fronted Geese, begun in 1990 in the Queen Maud Gulf Migratory Bird Sanctuary, is providing new data about these birds and their movements. This information allows for informed decision making about population management. Annual survival declined over this period, from a maximum of 87% in 1993 to the lowest estimate of less than 70% in 2000. Mean estimated lifespan has also decreased. From a former maximum of 7.8 years, lifespan would now be closer to 3.7 years, with a survival rate equivalent to that estimated in 2000 (Alisauskas 2002a).

The estimated Canadian harvest for 2009 was 53 213, a 43% decrease from the 2008 estimate and below the 10-year average (73 834; Table 14). In the U.S., the 2009 harvest was 205 244 birds, about 36% lower than the previous year's yield. Recent trends in the annual population index combined with relatively high harvest rates and evidence of declining survival remain a cause for caution with regard to the international management of mid-continent White-fronted Geese (D. Nieman, pers. comm.).

Canada Goose and Cackling Goose

Until recently, geese of the species *Branta canadensis* breeding in Canada were recognized as

a single species, although debate around the validity of this taxonomic clustering continued (summarized in Dickson 2000). Over the years, many authors suggested two species should be recognized: small-bodied birds with relatively short necks and bills, and larger-bodied birds with proportionately longer necks and bills (Mowbray *et al.* 2002). In 2003, after reviewing the genetic evidence, the American Ornithologists' Union identified two species of geese from the one species previously referred to as *B. canadensis* (Banks *et al.* 2003). Birds of the large bodied or *B. canadensis* group, consisting of seven subspecies, typically nest in inland and more southerly regions, while the four subspecies of the smaller Cackling Goose (*B. hutchinsii*) more typically breed in tundra habitats (www.sibleyguides.com/?s=cackling).

The many different races of Canada Goose (*B. canadensis*) and Cackling Goose (*B. hutchinsii*) that have part of their breeding range in Canada are grouped into 15 different management populations. The distribution of Canada Goose and Cackling Goose populations are shown in Figures 31a, 31b and 31c.

Table 15 presents overall harvest estimates for Canada and the United States. It should be pointed out, however, that these numbers are composed of birds from more than one population. Because the surveys cannot differentiate among the different populations of Canada Goose and Cackling Goose, they are inadequate for estimating the harvest level of each population. Partitioning of the harvest requires comprehensive banding programs or analysis of molecular markers. Harvest of Canada Geese and Cackling Geese has been on the rise, with the continental harvest surpassing 3 million annually since 2001. The estimated Canada and Cackling Goose harvest in 2009 was 711 213 birds in Canada, whereas about 2 705 672 geese were harvested in the U.S. (Table 15).

North Atlantic Population (NAP) Canada Goose

Canada Geese belonging to the North Atlantic population, which is thought to be primarily composed of the subspecies *B. c. canadensis*, breed in Labrador, insular Newfoundland, and eastern Quebec, including Anticosti Island (Figure 31a). The breeding population is surveyed by the helicopter plots of the Eastern Waterfowl Survey. An expanded helicopter plot survey was initiated in 2001 when it became evident that neither the original Eastern Waterfowl Survey nor the fixed-wing transects carried out by the USFWS adequately covered the breeding range of this population. Efforts to integrate data from the two survey platforms are ongoing.

Stratum 2 of the Eastern Waterfowl Survey approximates the breeding range of the NAP. A method for integrating the results of the two survey platforms is being developed; in the interim, the data from the helicopter plots only is presented in Figure 32. In 2010 the total estimated indicated pairs was 38 387, which is below to the average of the past decade (43 571; Figure 32).

Preliminary banding efforts undertaken in Labrador in the summers of 2007 and 2009 identified the presence of Canada Geese banded as juveniles in several northeastern U.S. states. As has been documented for other Canada Goose populations (see below), the presence of moulting, temperate-breeding migrant geese is a concern in terms of both the accuracy of breeding survey estimates and the potential effects on locally breeding geese of the North Atlantic population due to competition for resources.

Atlantic Population (AP) Canada Goose

Atlantic Population Canada Geese (composed largely of *B. c. interior)* nest throughout northern Quebec, especially along the shores of Ungava Bay and eastern Hudson Bay. A recent review by Mallory *et al.* (2005) added locations on Baffin and Somerset islands, Nunavut, that are more northerly than the known breeding range. Eastward across Baffin Bay, Canada Geese breeding in western Greenland appear related to the Atlantic population birds, based on measures of morphology and genetic characteristics (Fox *et al.* 1996; Scribner *et al.* 2003). Atlantic Population Canada Geese winter from New England to South Carolina, with the largest concentration occurring on the Delmarva Peninsula (Figure 31a).

In 1993, an annual breeding ground survey was introduced in northern Quebec with the objective of estimating the number of breeding pairs on the Ungava Peninsula (Harvey and Rodrigue 2010). Estimates produced by this survey are not adjusted for visibility bias and thus represent an index to the population. This survey covers the three regions that were shown previously to include the highest densities of nesting geese: the region of inland tundra, the region of flat coastal tundra (coastal Ungava Bay and Hudson Bay), and the region of taiga.

In 2010, the number of Canada Geese observed as pairs or as single birds (together representing the number of indicated breeding pairs) decreased 13% to 154 028, but this was not statistically different from the previous year (Harvey and Rodrigue 2010; Figure 33). The total population estimate in 2010 (776 212) was significantly lower than the 2009 estimate of 1 097 744 individuals (P = 0.002).

While the breeding pair and total population estimates have both risen nearly five-fold since 1995 (record low level of about 30 000 pairs), caution should be used when interpreting the estimate of total population size as it includes breeding pairs,

non-breeders, failed breeders and moulting migrants from other areas. Harvey and Rodrigue (2009) noted that the difference in density of breeding pairs has become much more obvious since 2001, with the Hudson Bay coast now supporting more than four times the density of breeding pairs as the Ungava Bay coast. This could be related to a number of factors, including differential survival or productivity rates; regardless the potential for growth appears to be more limited for geese nesting along the Ungava Bay coast.

In 2009-2010, winter temperatures were above-normal and snow fall was less than the region typically receives.. The spring thaw occurred slowly and conditions appeared average at the time of the survey. Snow remained longer on the Hudson Bay coast. Small or shallow lakes and ponds were open along both coasts, but larger lakes remained frozen (Harvey and Rodrigue 2010).

The mean nest initiation date at four monitored sites around Ungava Bay was 28 May, which is 7 days earlier than last year and 1 day earlier than the long-term average (1996-2010). The total number of nests found and the mean clutch size for the four sites surveyed along Ungava Bay were 58 and 3.8, respectively. Mean clutch size in 2010 was slightly lower than the long-term average of 3.91. Productivity of Atlantic Population Canada Geese on the Ungava Peninsula in 2010 should be moderate to good (Cotter 2010).

In the boreal forest, Canada Geese are counted as part of the Eastern Waterfowl Survey. Estimates for the recent decade (1999–2008) clearly remain above those for the 1990–1998 period. The region covered by the Eastern Waterfowl Survey is at the southern limit of the nesting range of AP Canada Geese.

Temperate-breeding Canada Goose in Eastern Canada

This population of Canada Geese nests in southern Ontario and southwestern Quebec. There is also a growing population in New Brunswick, Nova Scotia and Prince Edward Island, following deliberate re-establishment of local Canada Goose flocks beginning in the late 1960s. Though sometimes referred to as "resident," many migrate as far north as James and Hudson bays in Ontario and to northern Quebec during the moulting period, and some winter as far south as Virginia. In turn, an increasing number are remaining to overwinter in southern Ontario (Dennis *et al.* 2000). In addition to the growing numbers breeding in Canada, temperate-breeding Canada Geese in the eastern United States have also increased rapidly, and large numbers of subadults and failed breeders move to Canada for the moulting period.

As recently as 1970, Canada Geese did not commonly nest in southern Ontario. However, results of the Southern Ontario Breeding Waterfowl Survey show that the population south of the French and Mattawa rivers has grown to just over 100 000 breeding pairs in 2010 (S. Meyer, pers. comm.; Figure 34). After increasing at a rate of about 12% annually to 86 000 pairs in 2006, population growth has since slowed to about 5% per year. An unknown but increasing number of additional birds also breed locally north of the surveyed area, but south of the range of Ontario's two sub-arctic breeding populations. The estimated fall flight has increased from around 15 000 birds in the mid-1970s to just over 590 000 in 2010 (S. Meyer, pers. comm.).

In 2010, 3932 temperate-breeding Canada Geese were banded in southern Ontario.

Southern James Bay Population (SJBP) Canada Goose

The Southern James Bay Population (*B. c. interior*) of Canada Geese nest on Akimiski Island, Nunavut, in James Bay and in the adjacent lowlands of Ontario to the south and west. This population winters in an area extending from southern Ontario, Michigan and Ohio to Mississippi, Alabama and South Carolina (Figure 31a).

For some years there has been concern about the status of this population. From 1985 to 1988, mid-winter indices averaged about 154 000 birds, but in 1990 a spring breeding ground survey reported only about half that number. The spring population has been surveyed annually since then and there has been no real change in the size of the breeding population during the survey period (mid-May). The total breeding population in 2010 was estimated at 87 270 geese, 13% higher than in 2009 (Figure 35).

Beginning in 2007 the objective of the survey was refocused to measure change in the population, rather than compare annual population estimates. The modifications increase the ability to detect population change, but also mean that population estimates since 2007 are not directly comparable to those of previous years.

The estimate of indicated breeding pairs for Akimiski Island and the mainland combined (76 355) was not significantly different from 2009 and was well above the threshold level of 50 000 birds, at which changes to harvest regulations would be considered (Brook and Hughes 2010a).

Spring phenology was early in 2010 in southern James Bay. Nesting studies on Akimiski Island indicated an average nest density. However, in 2010, apparent nesting success was a record low and nest loss was the highest recorded for Akimiski Island (76.6%) (Brook *et al.* 2010).

Large numbers of moult-migrant temperate-breeding Canada Geese move to Akimiski Island and to adjacent coastal areas of James Bay and eastern Hudson Bay. For example, in 2010, 685 moult-migrant temperate-breeding Canada Geese

were captured and banded around this area. On breeding areas they may compete for food resources with SJBP goslings and, as a result, contribute to the high gosling mortality that is observed there in some years (Abraham *et al.* 1999b).

In July 2010, 3973 Canada Geese were banded along the James Bay coast south of Attawapiskat and on Akimiski Island (Hagey *et al.* 2010).

Mississippi Valley Population (MVP) Canada Goose

The nesting range for the Mississippi Valley population of Canada Goose (*B. c. interior)* is in northern Ontario, principally in the Hudson Bay lowlands, west of Hudson and James bays. MVP Canada Geese primarily concentrate during fall and winter in Wisconsin, Illinois and Michigan (USFWS 2010 (Figure 31a).

Spring phenology was early in 2010 (Brook and Hughes 2010b). The estimated 2010 breeding population of 339 310 (calculated number of indicated breeding pairs x 2) was up from 239 631 in 2009 and was only 6% below the 1989-2009 average (Figure 36, Brook and Hughes 2010b). Surveys indicated a total population of 359 687 Canada Geese, well below that of 2009 (518 232) and 40% below the1989-2009 average.

In July 2010, 4962 Canada Geese were banded on the coast of western James Bay north of Attawapiskat and on Hudson Bay (Hagey *et al.* 2010).

Eastern Prairie Population (EPP) Canada Goose

This Canada Goose population (*B. c. interior*) nests in the Hudson Bay lowlands of Manitoba. The birds overwinter in Manitoba, Minnesota and Missouri (USFWS 2010; Figure 31b). Spring surveys of Eastern Prairie Population Canada Geese have been flown annually since 1972, providing good baseline data for this population.

The 2010 survey estimate of single and paired EPP geese was 172 600, 2% higher than last year. The 2010 spring total population was estimated at 251 300, 10% lower than the 2009 estimate (Figure 37, USFWS 2010).

Western Prairie Population (WPP)/Great Plains Population (GPP) Canada Geese

The Western Prairie Population (*B. c. interior, moffitti* and *canadensis*) breeds in eastern Saskatchewan and western Manitoba, while the Great Plains Population (*B. c. moffitti*) results from restoration efforts in Saskatchewan, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas. Both populations winter with other Canada Geese along the Missouri River in South Dakota, and on reservoirs from southwestern Kansas to Texas (USFWS 2010, Figure 31b).

Separate indices for these two populations are not available from mid-winter surveys, as the fall and winter ranges of the WPP and GPP overlap. During the 2010 midwinter survey, 462 800 WPP/GPP geese were counted, 26% below last year's estimate. The midwinter estimates have decreased an average of 3% per year since 2001 (P = 0.262, USFWS 2010).

Canada Geese on the Canadian Prairies are also counted during the Waterfowl Breeding Population and Habitat Survey. A comparison of results from this survey and those of smaller-scale surveys in east-central Saskatchewan indicated that the spring waterfowl surveys provide a good measure of trends in populations (Nieman *et al.* 2000). Thus the annual Waterfowl Breeding Population and Habitat Survey could be used on an annual basis to assess the abundance of the various populations of large Canada Geese breeding on the Prairies (D. Nieman, pers. comm.). Results of spring waterfowl surveys in the Canadian Prairies indicated considerable increases (1027% and 2117%, respectively) in the populations of WPP and GPP Canada Geese between 1970 and 1999 (Nieman *et al.* 2000). The spring surveys in 2010 estimated 998 900 geese, 8% higher than last year (P = 0.451, USFWS 2010). Spring 2010 was average in the northern range of WPP. Wetland abundance was variable across southern Manitoba and Saskatchewan, but remained high in most GPP range (USFWS 2010).

Hi-Line Population (HLP) Canada Goose

The Hi-Line Population is composed of large Canada Geese (*B. c. moffitti*) that nest in southeastern Alberta, southwestern Saskatchewan, eastern Montana and Wyoming, and in Colorado. This population winters in Colorado and in central New Mexico (USFWS 2010, Figure 31c).

HLP Canada Geese are also counted during the Waterfowl Breeding Population and Habitat Survey. Results of the surveys in the Canadian Prairies indicated a considerable increase (1089%) in the population between 1970 and 1999 (Nieman *et al.* 2000). The 2010 Waterfowl Breeding Population and Habitat Survey estimate for Saskatchewan, Alberta, Montana and Wyoming was 277 600 geese, 9% lower than the 2009 estimate. The WBPHS population estimates have increased an average of 3% per year during 2001–2010 (USFWS 2010).

Rocky Mountain Population (RMP) Canada Goose

The Rocky Mountain Population (RMP) of Canada Geese nests in southern Alberta, the inter-mountain regions of Utah, Idaho, Nevada, Colorado, and Wyoming, and in western Montana. They winter

in central and southern California, Arizona, Nevada, Utah, Idaho, and Montana (Figure 31c).

RMP Canada Geese are also counted during the Waterfowl Breeding Population and Habitat Survey. Spring waterfowl surveys in southern Alberta, and RMP states provided an estimate of 148 900 geese, 15% more than the estimate from 2009. These estimates indicate no trend during 2001-2010 (P = 0.720, USFWS 2010). Results from the surveys in the Canadian Prairies indicated a considerable increase in the population (508%) between 1970 and 1999 (Nieman *et al.* 2000).

Pacific Population (PP) Canada Goose

The Pacific Population (PP) of Canada Geese nests and winters west of the Rocky Mountains from northern Alberta and British Columbia south through the Pacific Northwest to California (USFWS 2010, Figure 31c). In Canada, this goose population breeds in central and southern British Columbia and it comprises both migratory and non-migratory (resident) segments. The breeding segment appears to have stabilized, at least in some areas.

Breeding Pacific Canada Goose are surveyed in the course of the two major surveys used to estimate trends in duck populations in British Columbia: the large-scale (11 million hectare) aerial survey of the B.C. Interior and the replicated series of ground counts covering selected wetlands of the Southern and Central Interior Plateau of B.C. Ground counts were modified in 2007 to focus on managed and protected wetlands.

Aerial surveys of breeding waterfowl have been conducted in the Central Interior Plateau of British Columbia in May 2006, and repeated annually since then, over an area covering in excess of 10 million hectares. The survey used a strip-transect total count method similar to the one used for the mid-continent breeding waterfowl survey, although all waterfowl sightings are georeferenced and associated with a unique habitat type (i.e. stream, wetland, river, lake, agricultural field) and ecological unit (ecosection) to allow for the subsequent determination of ecosystem-specific, habitat-to-species relationships and the development of landscape use models. Pacific Canada Goose population estimates are calculated separately for each ecosection and also for the entire survey area. We estimated the presence of 16 363 Pacific Canada Geese in the surveyed portion of the B.C. Interior in May 2010, a 24% decrease compared to the 21 463 birds estimated in May 2009.

The non-migratory segment is concentrated in the urban and suburban areas of southwestern British Columbia (particularly the Greater Vancouver and Greater Victoria areas) and nearby agricultural lands (A. Breault, pers. comm.). Problem populations of resident and urban Canada Geese are primarily controlled by municipalities and through federal hunting regulations. Key management practices include egg addling (operational in the lower mainland of B.C. for over 10 years), prevention of nesting, landscape management and relocation of moulting flocks to areas where they can be subjected to hunting mortality. Split hunting seasons have been successful in increasing the number of Canada Geese harvested in some agricultural areas and special permits are issued to protect crops and property (A. Breault, pers. comm.).

Lesser Canada Goose

Lesser Canada Geese (*B. c. parvipes*) breed throughout much of Alaska and migrate along the Pacific coast to winter in Washington, Oregon and California (USFWS 2010, Figure 31c). As they winter with other populations of Canada Geese, there is no reliable mid-winter index for this population. Using breeding population survey data as an index, 2010 numbers of Lesser Canada Geese and Taverner's Cackling Geese (*B. h. taverneri*) were estimated at 78 200, which was 15% higher than the 2009 estimate. These estimates have declined an average of 1% per year since 2001 (USFWS 2010).

Short-grass Prairie Population (SGPP) Canada/Cackling Goose

The Short-grass Prairie Population of geese breeds in the western Arctic on Victoria and Jenny Lind islands, and on the Nunavut and N.W.T. mainland from Queen Maud Gulf to the Mackenzie River and south into northern Alberta. They winter in the dry agricultural lands of southeastern Colorado and northeastern New Mexico, and in the Oklahoma and Texas panhandles (Figure 31c). This population is thought to be comprised of two species of white-cheeked geese, the Lesser Canada Goose (*B. c. parvipes*) and Richardson's Cackling Goose (*B. h. hutchinsii*) (Hines *et al.* 2000).

Management concern has been expressed about this population, which has declined at a rate of 2% per year since 1999 (P = 0.484). Counts on the winter grounds provided an index of SGPP Canada Geese in 2010 of 290 700, 32% higher than in 2009 (USFWS 2010). In general, the declining counts on the wintering grounds (where different populations of Canada and Cackling Geese are known to mix to varying degrees each year) do not appear to be compatible with surveys on the breeding grounds, which show increasing or stable populations.

Aerial transect surveys covering much of the breeding range of these Canada and Cackling Geese populations in the Inuvialuit Settlement Region (ISR), on the mainland, and on Victoria and Banks islands, were conducted in June 1989–1993 (Hines *et al.* 2000). Repeat surveys of many of these

transects were carried out in 2002–2006. The aerial counts indicated that there were more than 70 000 SGPP Canada and Cackling Geese in or near the survey area. However, the survey did not cover all of the breeding range of geese in the ISR. It was suspected that from 5 000 to 10 000 geese might not have been counted. Overall, the counts indicate that geese (predominantly *B. hutchinsii*) on Victoria Island and Banks Island have apparently increased in numbers and have possibly extended their breeding range northward over the past few decades. In contrast, results of spring waterfowl surveys suggested that SGPP Canada Geese in the boreal forest and taiga of the Northwest Territories, Yukon and eastern Alaska had remained relatively stable since the 1960s (Hines *et al.* 2000).

A new survey sponsored by NAWMP's Arctic Goose Joint Venture and the Sea Duck Joint Venture was flown in spring 2010 over the coastal area of the Western part of the Northwest Territories, and estimated 247 300 Canada/Cackling Geese, a 84% increase from 2009. Estimates from the spring breeding survey have increased an average of 6% per year since 2001 (USFWS 2010).

The population status must be watched closely, following an analysis by Alisauskas (2002b) which suggested that the mean expected lifespan of SGPP geese has been declining since the 1992 high of 7.1 years, to a 2000 estimate of 3.4 years. He also demonstrated that annual survival has similarly dropped over that time period from 87% to 74%.

Tall Grass Prairie Population (TGPP) Cackling Goose

The Tall Grass Prairie Population of Cackling Goose (*B. h. hutchinsii)* nests on Baffin (the Great Plains of the Koukdjuak), Southampton and King William islands, in tundra habitats along the northern mainland coast of Nunavut, and along the shores of the west coast of Hudson Bay. It winters mainly in Arkansas, Louisiana, Oklahoma, Texas and northeastern Mexico (Figure 31b).

Aerial surveys of TGPP Cackling Geese were initiated in 1992 (Rusch *et al.* 1996) and, unlike other spring surveys, are conducted during the brood-rearing period. Population estimates available for Baffin Island from 1993 through 2008 indicate a population of about 100 000 breeding birds. Of the past several years of study, there were three years when almost no young were produced (1992, 1996 and 1999). TGPP Cackling Geese are also counted on the wintering grounds, but because they mix with other populations of Canada and Cackling Geese, it is difficult to estimate population size accurately. During the 2010 midwinter survey in the Central Flyway, 417 000 TGPP geese were counted, 35% more than last year. These estimates have increased an average of 3% per year during 2001–2010 (USFWS 2010).

A preliminary study of nesting geese on Southampton Island was conducted in 2010 at East Bay, and results suggest that Cackling Goose numbers have increased greatly since similar studies were conducted in 1979-1980 (K.F. Abraham, pers. comm.). In addition, systematic aerial surveys of Southampton and Coats Islands were conducted for the first time by a joint CWS-USFWS survey crew in late June of 2010. Surveys indicated high densities of nesting Cackling Geese in lowland habitats near Boas River and East Bay on Southampton Island. High densities of Cackling Geese were also noted in much of the lowland habitat surveyed on Coats Island. The TGPP nests mainly in eastern Arctic regions of Canada, where spring phenology was early in 2010. As a result of favourable conditions, production of TGPP Cackling Geese was expected to be good in 2010.

Brant

Based on breeding and wintering ranges, as well as on genetic differentiation, there are four distinct populations of brant (*Branta bernicla*) recognized in North America (Reed *et al.* 1998b; see below). Compared to most other geese, brant are more vulnerable to sporadic heavy losses from starvation and periodic nesting failures, because of their strong dependence on specific forage plants and the harsh environments where some populations live. This vulnerability requires careful regulation of hunting and monitoring of the status of populations (Reed *et al.* 1998b). Reed *et al.* (1998b) provide a review of the information available on this species in North America.

Atlantic Brant

This population of the subspecies *B. b. hrota* nests around Foxe Basin in the eastern low Arctic. It winters along the Atlantic Coast from Massachusetts to North Carolina (Reed *et al.* 1998b). Based on mid-winter counts in the Atlantic Flyway, there is great fluctuation in the population size of Atlantic Brant (Figure 38; Klimstra and Padding 2010). In 2010, the mid-winter population survey gave an estimate of about 139 700 Atlantic Brant, down about 8% from the previous year. The population estimates have shown no trend during the past decade (USFWS 2010).

Eastern High Arctic Brant

This group of *B. b. hrota* breeds on islands of the eastern high Arctic, migrating via Greenland and Iceland to winter in Ireland (Reed *et al.* 1998b). The number of Eastern High Arctic Brant is estimated through counts on the staging areas in Iceland and the wintering grounds in Ireland, where the

population grew from fewer than 10 000 birds in the late 1960s to more than 33 000 in 2004–2005. Preliminary results of the 2009 International Census estimated a population of about 38 000 birds. Numbers were slightly higher (less than 1%) than the previous year (Wildfowl and Wetlands Trust 2010).

The percentage of young is also assessed during the fall census. As is the case for most Arctic birds, productivity fluctuates markedly between years; only 1–2% of the population are comprised of young birds in poor years and as many as 20–30% in good years. Breeding success was the lowest recorded since the mid-1970s, with the proportion of young being 18% lower than in 2008 and well below the most recent 10-year mean (1999/00-2008/09, 14.6% ± 3.2 SE) (Wildfowl and Wetlands Trust 2010).

Black Brant

This population of brant (*B. b. nigricans*) nests in the central and western low Canadian Arctic, in Alaska and western Russia. It winters along the Pacific Coast, but mainly in Mexico (Reed *et al.* 1998b). Based on mid-winter counts in the Pacific Flyway, numbers of Black Brant are lower now than in the early 1960s (Figure 39; Collins and Trost 2010). The mid-winter index for Brant was 143 947 in 2010, 2% lower than in 2008 (no surveys were conducted in January 2009). Note that Black Brant numbers are obtained by subtracting Western High Arctic Brant counts in north Puget Sound (Padilla, Samish and Fidalgo bays [Washington]; D. Kraege, pers. comm.) from the total mid-winter counts in the Pacific, and Black Brant counts could also include a small proportion of Western High Arctic Brant.

There are no regular surveys of their breeding grounds, but aerial surveys of Black Brant were conducted in June 1995–1998 in the Inuvialuit Settlement Region. The results suggested that the total population of the Mackenzie Delta, Tuktoyaktuk Peninsula and Liverpool Bay likely exceeded 6000 birds (Hines and Wiebe Robertson 2006). Preliminary mark-recapture and band-recovery estimates suggest that survival rates of adult brant are relatively high (J. Hines, unpubl. data).

Part of the Black Brant population stages along the coast of British Columbia during spring migration. It is estimated that 3000 to 7000 brant stop over in the Queen Charlotte Islands on their way to northern breeding grounds. Roughly 25 000–30 000 Black Brant stage in the Strait of Georgia, B.C., with the Fraser River delta and the Parksville-Qualicum area on Vancouver Island being the two most important sites. A statistical model was developed to estimate the volume (total number) of birds moving through the Strait (Hagmeier 2002, Hagmeier *et al.* 2008).

Historically, between 1 000 and 10 000 brant spent the winter in British Columbia. More recent estimates of the wintering population in B.C. suggest 1500 individuals are found at two locations, including an estimated 600 to 700 individuals wintering in the Queen Charlotte Islands (Goudie and Hearne 1997; A. Breault, unpubl. data). In the areas of Boundary Bay and Robert's Banks of the Fraser River Delta, the wintering brant population has been generally increasing since 1992. The peak winter population was estimated at 2669 brant during the winter of 2009–2010, a 5% increase over the 2574 birds observed during the previous winter (Collins and Trost, 2010). An estimated 10 brant wintered on Vancouver Island in 2009–2010, the 15th year of consecutive wintering use (A. Breault, pers. comm.). The reasons for the increase in the number of brant wintering in the Fraser River Delta is unknown, but is likely due to a combination of increased recruitment in the local population, a reduction in the sport harvest, and an influx of Western High Arctic Brant from Washington State (S. Boyd, pers. comm.).

Western High Arctic Brant

This population (also known as Gray-bellied Brant) is intermediate in appearance between *B. b. nigricans* and *B. b. hrota*, and is thought by some biologists to be a unique subspecies. It breeds on islands of the western high Arctic and winters in Puget Sound, Washington (Reed *et al.* 1998b). Mid-winter counts suggest relatively large fluctuations in the population size of Western High Arctic Brant (Figure 39).

The Western High Arctic index count from Washington State for 2010 was 6019 birds, 63% lower than in 2009, but comparable to indices prior 2009 (Collins and Trost 2010).

Western High Arctic Brant are of management concern given their limited number, potentially unique subspecies status, and restricted winter distribution. In 2005, Western High Arctic Brant were satellite-tagged on their moulting grounds in the Arctic. The resulting data were used to map southward and northward migration routes, timing of migration, important staging sites, and habitat use patterns at Izembek Lagoon, Alaska, an important fall staging site. In addition to marking birds, blood sample were taken to test the degree of genetic distinctiveness of the Western High Arctic Brant from other brant stocks breeding and wintering in North America. DNA lab analyses have been completed but the results need to be summarized (S. Boyd, pers. comm.).

Population Status of Swans

Two species of swans are native to Canada: the Tundra Swan (*Cygnus columbianus*) and Trumpeter Swan (*C. buccinator*).

Tundra Swan

There are two populations of Tundra Swans. The western population breeds along the coastal lowlands of western Alaska and migrates through Western Canada and along the Pacific Coast. This population winters primarily in California, Utah and the Pacific Northwest. The eastern population of Tundra Swans breeds from the Seward Peninsula of Alaska to the northeast shore of Hudson Bay and Baffin Island, and migrates through the Prairie Provinces and Eastern Canada. This population winters in coastal areas from Maryland to North Carolina along the mid-Atlantic coast.

The 2010 mid-winter survey of Eastern Population Tundra Swans observed 97300 swans (swans counted in Ontario and the Atlantic and Mississippi Flyways). This number was 3% lower than the 2009 index (USFWS 2010). This population steadily increased through the 1970s and 1980s, and during the 1990s fluctuated around 90 000 birds. These estimates decreased by an average of 1% per year during 2001–2010 (USFWS 2010).

The Mackenzie Delta region and nearby parts of the Western Arctic mainland are one of the most important breeding areas for Tundra Swans in North America and support about one-third of the Eastern Population of this species.

The number of individuals from the Eastern Population killed and retrieved in the U.S. in 2009 was 3727, unchanged from the previous year and about equal to the long-term average (3278 birds annually from 1980 to 2009) (Klimstra and Paddling 2010). There are no open seasons for Tundra Swans in Canada.

A migration study using satellite transmitters (Petrie and Wilcox 2003) demonstrated that eastern Tundra Swans migrated between the wintering areas on the Atlantic coast and staging points in the northern prairies along a narrow corridor passing through the southern Great Lakes. From there, three major routes were followed to breeding areas in western Hudson Bay, the central High Arctic and the Mackenzie River Delta. To see the migration routes taken by the swans, visit the following web site: www.bsc-eoc.org/research/lpwwrf/index.jsp?lang=EN&targetpg=lpwwrfTUSWtrack.

About 76 700 Tundra Swans were estimated to comprise the western population, as counted during the 2010 midwinter survey. This count was 27% lower than in the previous year. However, several important swan wintering areas in California were not surveyed in 2010 (USFWS 2010). The harvest of western Tundra Swans in 2009 was estimated at 1217 birds, which is similar to the average annual harvest between 1962 and 2009 (average of 1010 swans; Klimstra and Padding 2010).

Trumpeter Swan

There are three populations of Trumpeter Swans: the Pacific Coast Population, the Rocky Mountain Population, and the Interior Population. The size of each of those populations is assessed at five-year intervals across their entire breeding range in North America. The most recent survey results available are from August–September 2005 (the survey is repeated every five years). Analyses of the 2005 data indicate that Trumpeter Swan breeding populations were at a record-high level in Alberta, British Columbia and the Yukon (Moser 2006). A range-wide survey was scheduled for 2010.

During the winter period over 40% of the Pacific Coast Trumpeter Swans population is present on the coastline, wetlands and agricultural fields of Vancouver Island and the Fraser River Valley in British Columbia; this is the largest wintering Trumpeter Swan concentration in North America. Aerial surveys of the area's wintering population have been conducted every three years over this entire area, to identify regional and habitat-specific trends in swan use. During the most recent survey in January and February 2006, estuaries, coastal marshes, farmland and freshwater lakes were the most important wintering sites on Vancouver Island, and swans were distributed almost equally between tidal marshes and upland habitats in the Fraser River Valley. The survey estimated a total of 7570 swans, an 11.7% decrease over the 6775 swans observed in 2000–2001. The mid-winter survey of Vancouver Island and the southwest Mainland Coast scheduled for the winter 2009–2010 was cancelled because of flying restrictions around Vancouver and the Strait of Georgia due to the 2010 Olympics. During the 2008–2009 survey of snow geese in the Fraser River Delta, swan groups were either counted (<20) or photographed. Pictures were subsequently analyzed for total count and percentage of young. No counts of Trumpeter Swans were conducted in 2009-2010 in the Fraser River delta (S. Boyd, pers. comm.).

Between 1999 and 2010, over 2200 Trumpeter Swans died of lead poisoning (the major cause of death was ingested lead shot [A. Breault, pers. comm.]) in the Fraser River Valley and in adjacent areas of Washington State. Approximately 150 Trumpeter Swans died in 2009–2010 (L. Wilson, pers. comm.). Lead poisoning losses are responsible for some of the decline in the number of wintering Trumpeter Swans observed since 1998. International efforts overseen by the Washington Department of Fish and Game and the Canadian Wildlife Service were initiated in 2001 to locate the source(s) of lead. These efforts have focused on population surveys conducted by volunteers, trapping and telemetry of banded birds to characterize habitat use, monitoring roost sites to track and collect sick birds, post-mortem examinations of dead birds to confirm the

cause of death, and, more recently, the hazing of birds away from Judson Lake.

In Ontario, a re-introduction program begun in 1982 has now achieved its goal of at least 500 free-living swans (H. Lumsden, unpubl. data). Surveys conducted in 2005 as part of the continental five-year survey of Trumpeter Swans showed a total population of 644 swans in Ontario (Moser 2006). The captive-breeding and release program ended in 2006; it is expected that the wild population will maintain itself and colonize additional suitable habitats over time without further releases of captive-bred birds.

Population Status of Other Hunted Migratory Birds

Thick-billed and Common Murres

Thick-billed Murres (*Uria lomvia*) and Common Murres (*U. aalge*) have traditionally been hunted off the coast of Newfoundland and Labrador. Murres have a limited ability to rebuild their numbers, as they first breed only at the age of four or five and then lay only one egg each year. If over-harvested, murre populations would take a long time to recover.

An analysis in the early 1990s of the demography of murres and the impacts of harvesting suggested that the annual harvest was unsustainable at that time. The number of Thick-billed Murres in the northwest Atlantic has been estimated to be close to 2.0 million pairs in the Canadian Arctic and 375 000 breeding pairs in Greenland (Petersen *et al.* 2008). The number of Common Murres breeding in Newfoundland and Labrador had been estimated to be 600 000 pairs (S. Gilliland, pers. comm.).

Since the 1970s, Thick-billed Murre numbers in selected colonies in the Eastern Canadian Arctic have been monitored by counts of occupied breeding sites on fixed study plots scattered throughout the colony. During the period 1976–2000, trends in these monitoring counts were generally either stable or positive (up 1 to 2% per year; $P < 0.01$), except for a sharp fall in numbers in 1989 and 1990 ($P < 0.01$). A sharp drop in population occurred between 2000–2002, with indices at two colonies falling by 25% ($P < 0.01$) and 9% ($P < 0.05$). Since then, after a partial recovery in 2003, the population indices have remained more or less stable to 2009 (Gaston, pers. comm.). The cause of these population fluctuations is not known, but is probably related to events in the wintering grounds rather than the breeding grounds (Gaston 2003). Similar trends have been seen in Common Murres breeding in southern Newfoundland at Cape St. Mary's, with declines throughout the 1980s and increases since 1989 (P. Regular, pers. comm.).

Recovery rates of juvenile Thick-billed Murres between 1984 and 2004 ranged from 0.0 to 2.6% and have declined in recent years. From 2001 to 2008 juvenile Common Murre recovery rates have ranged from 0.0 to 2.5% for Newfoundland colonies and from 1.7 to 5.2% for Labrador colonies. Breeding adult recovery rates are very low for Thick-billed Murres (3 of 2345 banded from 1984–2002 or 0.1%) and Common Murres (0 of 385 banded from 2001–2007). Consequently, apparent survival rates of breeding adult Common Murres between 1996 and 2003 were high (93–97%; Robertson *et al.* 2006).

Beginning in the 1993–1994 hunting season, CWS implemented restrictions on murre hunting in Newfoundland and Labrador. The restrictions were designed to reduce the harvest of murres by up to 50%, to eliminate excessive kills that lead to illegal sale and to provide additional protection to other seabirds such as razorbills (*Alca torda*). These interim restrictions had been taken while steps were underway to amend the *Migratory Birds Convention Act* between Canada and the United States. Beginning with the 2000–2001 hunting season, an amendment to the Convention now enables murres to be managed through the usual regulatory approaches.

The annual murre harvest has been estimated several times since the 1977–1978 hunting season using a special survey mailed to Migratory Game Bird Hunting Permit holders. Overall, the murre harvest has declined since the late 1970s, with estimates being the lowest in the last three surveys, following the imposition of hunting restrictions. Excluding the very high estimate for 1982–1983, the average harvest estimate for permit holders prior to the introduction of the hunting restrictions was about 400 000 birds per year, compared to 134 000 birds per year after the restrictions. Thus, the annual harvest was reduced by about 66%, exceeding the target of 50%. Accounting for murre hunters who, until 2000, were not required to purchase a hunting permit, the total annual harvest of murres was assessed at about 250 000 to 300 000 birds between 1996 and 1998, compared to 600 000 to 900 000 birds prior to the hunting restrictions.

The hunting season of 2001–2002 was the first year when all murre hunters were required to purchase a hunting permit, and hence the first year that the total murre harvest could be estimated. The results indicated that there were about 6400 murre hunters in Newfoundland and Labrador in 2001–2002, of which about 18% bought permits just to hunt murres. In 2002–2003, the estimate was essentially unchanged at about 6500 hunters. The total estimated harvest for 2001–2002 was about 186 000 murres, while the harvest was an estimated 158 000 birds in 2002–2003 (Collins and Gobeil

2003). Murres are now captured on the National Harvest Survey. In 2008–2009, close to 118 000 murres were estimated to have been harvested in Newfoundland and Labrador, which is 9% greater than the 2007–2008 estimate (M. Gendron, pers. comm.).

American Woodcock

The status of American Woodcock (*Scolopax minor*) in North America is monitored through the Singing-ground Survey, which consists of a spring count of male courtship displays at dusk. Counts of singing males provide indices to American Woodcock populations and can be used to monitor annual population changes (Cooper and Parker 2010). The survey covers the central and northern portions of the woodcock breeding range. Analyses of band recoveries indicate that there are two relatively discrete populations, and as a result, American Woodcock are managed on the basis of two regions: Eastern and Central. In Canada, woodcock breeding in Manitoba and Ontario belong to the Central Population, while those breeding in Quebec and in the Maritimes are part of the Eastern Population.

Population indices for the 1968–2010 trend were estimated using hierarchical modeling methods (Sauer *et al.* 2008). Indices for singing American Woodcock males in the eastern and central regions were not significantly different from 2009. For the seventh consecutive year, there was no significant 10-year trend (2000–2010) in the eastern region. However, the 10-year trend in the central region showed a significant decline (Figure 40; Cooper and Parker 2010).

In Canada, the only significant trends observed in the number of American Woodcock were long-term (1968-2010) declines in Nova Scotia and Ontario, as well as a short-term (2000-2010) decline in Ontario (Cooper and Parker 2010).

The major causes for American Woodcock population declines are believed to be degradation and loss of suitable (early successional) habitat on both the wintering and breeding grounds (Kelley *et al.* (eds) 2008).

An indirect measurement of recruitment or annual productivity of woodcock breeding populations is derived from age ratios of wings collected from the harvest (Wing-collection Survey). The 2009 recruitment index for the Eastern Region (1.5 immatures per adult female) was 8.6% lower than the 2008 average and 11.5% below the long-term (1963–2008) regional average. In the Central Region, the 2009 recruitment index (1.2 immatures per adult female) was 20.3% lower than the 2008 average and 25.6% lower than the long-term (1963-2008) regional average (Cooper and Parker 2010).

The harvest of American Woodcock in Canada and the U.S. has been declining over the years; this decline, however, was much more pronounced in the United States until recently (Figure 41). In 2009, there were 16 949 woodcock harvested in Canada, which was 37% below the harvest level of 2007 (Figure 41). In the U.S., the 2009 harvest was estimated at 238 400 woodcock, a decline of 15% over the harvest of 2008.

Mourning Dove

Mourning Doves (*Zenaida macroura*) are among the most widely distributed and abundant birds in North America, and are monitored in Canada through the Breeding Bird Survey (C. Downes; www.cws-scf.ec.gc.ca/mgbc/trends/index.cfm?lang=e&go=home.page&CFID=10699963&CFTOKEN=36995251).

Mourning Dove populations in the Lower Great Lakes/St. Lawrence Plain, Atlantic Northern Forest and Prairie Pothole ecozones have increased significantly ($P < 0.05$) over the long term (1968–2008). Populations in other ecozones do not show any significant trend over that time period. Similarly, there were no significant trends in any ecozone over the past decade (1998–2008).

In the U.S., Mourning Dove populations are monitored through the Mourning Dove Call-count Survey, which has been developed to provide an annual index to population size during the breeding season. Mourning Doves are managed on the basis of the three regions where dove populations are largely independent. These areas are referred to as the Eastern, Central and Western Management Units. Results from the Call-count survey indicated that abundance of doves decreased in all three management units during the 44-year survey period (1966-2010). Over the most recent 10-year period (2001–2010), there was an increase in doves heard for the Eastern Management Unit (Sanders and Parker 2010).

Dove hunting is permitted in several states in each of the three Management Units in the United States. In Canada, Mourning Doves are hunted in British Columbia. The harvest in British Columbia varies considerably from year to year, ranging from an estimated high of 5391 doves killed in 1977 to 95 during the 2008 season. The preliminary estimate of harvest in the U.S. for 2009 was 17 354 800 ± 6%, a decline from the harvest of the 2008 season which was 17 402 400 ± 5% (Sanders and Parker 2010).

Wilson's (Common) Snipe

Wilson's Snipe (*Gallinago delicata*) in Canada are also monitored through the Breeding Bird Survey (C. Downes; www.cws-

scf.ec.gc.ca/mgbc/trends/index.cfm?lang=e&go=home.page&CFID=10699963&CFTOKEN=36995251).

Populations of Wilson's Snipe in the Boreal Softwood Shield and Northern Rockies ecozones have increased significantly ($P < 0.05$) over the long term (1968–2008). Populations in the Atlantic Northern Forest ecozone showed a significant decline over this same time period. No long-term trends were observed elsewhere in the country. Wilson's Snipe declined significantly over the last decade (1998–2008) in the Great Basin and Boreal Hardwood Transition ecozones, whereas the species increased significantly in the Boreal Taiga Plains ecozone during the same period. The harvest of this species in Canada appears to have stabilized at a low level over the past decade (Figure 42). In 2009, there were 2632 (± 620) snipe harvested in Canada, an increase from 2008. The estimated harvest in the U.S. for 2009 was 83 500 birds (± 45%), which was lower than the previous year (Raftovich *et al.* 2010).

Sandhill Crane

The Mid-continent Population of Sandhill Cranes is the largest of all North American crane populations. This population is comprised of approximately two-thirds Lesser (*Grus canadensis canadensis*), one-fourth Canadian (*G. c. rowani*), and the remainder Greater Sandhill Cranes (*G. c. tabida*). Mid-continent Sandhill Cranes breed from southern Ontario northwestward through the Arctic, Alaska, and into eastern Siberia. This population winters in western Oklahoma, eastern New Mexico, Texas, southward into Mexico, and westward into Arizona (Kruse *et al.* 2010).

The Mid-continent Population of Sandhill Cranes is monitored through a spring aerial transect survey at the key staging area in Nebraska. Indices corrected for visibility bias are available since 1982. They have been relatively stable since the early 1980s. The uncorrected population index in spring 2010 was 451 024 birds (Kruse *et al.* 2010, Figure 43).The photo-corrected, three-year average for 2007–2009 was 498 420, which is above the established population-objective range of 349 000-472 000 cranes. (Kruse *et al.* 2010).

The Canadian hunting season for Mid-continent Sandhill Cranes is currently open only in Manitoba, Saskatchewan and the Yukon Territory. The crane harvest in Canada has been quite variable, tending toward an increase in the early 2000s (Figure 44). The overall Canadian harvest of Mid-continent Sandhill Cranes was 4165 (±444) in 2009, which is a decline compared to the past decade (average of 9674; Figure 44). The harvest of Mid-continent Sandhill Cranes has been increasing in the U.S. over the years. The crane harvest in the U.S. decreased by 34% to 16 368 in 2009 compared to the previous year where a record high level was reached (24 705; Figure 44; Kruse *et al.* 2010).

Less is known about the Eastern Population of Sandhill Cranes. This population breeds in Ontario, Quebec and several Great Lakes states. Eastern Population Sandhill Cranes are presently not harvested anywhere within their range. However, with the development of a Management Plan for the Eastern Population in the Mississippi and Atlantic Flyways, the states of Tennessee and Kentucky are now proposing seasons for 2013. In Ontario, recent ongoing studies have shown that over 9000 cranes stage in the fall along the north shore of Lake Huron. In addition, with the deployment of satellite telemetry units, the migration and breeding range of the cranes using this area is now being delineated (S. Meyer, pers. comm.).

Band-tailed Pigeon

Limited information is available on the status of the Band-tailed Pigeons (*Columba fasciata*) found in forested habitats of coastal British Columbia. This species has a very low reproductive rate of one egg per pair, but some nest twice each season. Results from the Breeding Bird Survey (C. Downes; www.cws-scf.ec.gc.ca/mgbc/trends/index.cfm?lang=e&go=home.page&CFID=10699963&CFTOKEN=36995251) indicate no significant trend in the population over the long term (1968–2008) or in the last 10 years (1997–2008).

As an alternative mechanism by which to understand population trends in Band-tailed Pigeons, in 2001 the species was assessed at over 15 mineral sites for which there were historic records for comparison. These counts were integrated into a Flyway-wide index of use of mineral sites, including California, Washington, Oregon and British Columbia (Casazza and Pacific Flyway Band-tailed Pigeon Sub-committee, pers. comm.). Preliminary analyses of the data collected at four mineral sites in British Columbia in the summer of 2010 suggest a 34% decline over the 2009 numbers and a 37% decline over the 2001–2009 average (A. Breault, pers. comm.).

The Canadian hunting season for this species was closed from 1994 through 2001. Population increases in Washington State were primarily responsible for the limited opening implemented in British Columbia in 2001 (where the bag limit was reduced from 10 birds to 5 and the season length reduced from 30 to 15 days). The harvest estimate for Band-tailed Pigeon was 108 ± 46 in 2009 in Canada. The harvest continues to decline, in comparison to the early 1970s when between 3000 and 5000 were harvested annually. In 2009 in Canada, 231 birds were harvested, around half of

last year's number. The estimated total U.S. harvest for 2009 was 27 600 ± 23% Band-tailed Pigeons, a 26% decrease from last year (Raftovich *et al.* 2010).

American Coot

American Coots (*Fulica americana*) are also recorded in the Canadian Prairies as part of the Waterfowl Breeding Population and Habitat Survey. Results of this survey show that American Coot population estimates have fluctuated greatly over the duration of the survey (Figure 45), with a tendency to show an increasing trend. In 2010 the population declined to 971 330 coots following the record-high estimate of 2.4 million in 2008. This returns the coot population to a value in line with the historical declining trend.

The harvest of American Coots in Canada has fallen considerably over time. In 2009, the American Coot harvest was estimated at 2754, a decrease of 26% from the previous year. The total harvest in the U.S. in 2009 was 219 000 (±34%) a decrease over the 2008 harvest estimate of 275 900 (Raftovich *et al.* 2010), about the same as in 2007.

Rails

Although rails are counted during the Breeding Bird Survey (BBS), their sometimes secretive nature and infrequent calling means they are likely to be missed during the BBS. The results of trend analyses should therefore be viewed with caution (C. Downes; www.cws-scf.ec.gc.ca/mgbc/trends/index.cfm?lang=e&go=home.page&CFID=10699963&CFTOKEN=36995251

There is sufficient sample size to estimate trends for Virginia Rails (*Rallus limicola*) for the country as a whole during the long-term period (1968–1988), as well as for the last 20-year trends in the Lower Great Lakes/St. Lawrence Plain. However, none of these trends is significant.

Sora (*Porzana carolina*) trends are available for the Boreal Taiga Plains, Great Basin, Northern Rockies, Prairie Potholes, Boreal Hardwood Transition, Great Lakes/St. Lawrence Plain and Atlantic Northern Forest ecozones. Sora population indices showed a significant long-term increase in the Northern Rockies ecozone, and a significant long term decline in the Boreal Hardwood Transition. In the most recent decade, the trend is significantly positive in the Boreal Taiga Plains exozone.

Trends are not reliable for the Yellow Rail (*Coturnicops noveboracensis*) or King Rail (*Rallus elegans)* because of relatively low numbers observed or heard during the surveys.

The only province with an open season on hunting rails is Ontario (excluding King Rails and Yellow Rails). Other provinces previously held seasons but they have been closed in recent years. The collection of harvest data for rails began in 1989 as part of the National Harvest Survey. Since that time, between 100 and 4000 rails have been harvested annually. The total harvest in 2009 was 101 birds.

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Appendices

APPENDIX A - *Special Conservation Measures for Fall 2010 and Spring 2011*

MEASURES IN QUEBEC CONCERNING OVERABUNDANT SPECIES

Item	Column 1 Area	Column 2 Period during which Snow Geese may be killed	Column 3 Additional hunting method or equipment
1.	District A	May 1 to June 30 and September 1 to December 10	Recorded bird calls (*d*),(*f*)
2.	District B	September 18 to January 1	Recorded bird calls (*d*),(*f*)
3.	Districts C and D	March 1 to May 31(*a*), September 1 to September 17(*a*), and September 18 to January 1	Recorded bird calls (*d*),(*f*)
4.	District E	March 1 to May 31(*a*), September 1 to September 17(*a*), and September 18 to January 1	Recorded bird calls (*d*),(*f*) and bait or bait crop area (*e*)
5.	Districts F	March 1 to May 31(*a*),(*b*),(*c*), September 6 to September 24 (*a*), and September 25 to January 8	Recorded bird calls (*d*),(*f*) and bait or bait crop area (*e*)
6.	District G	September 25 to December 26	Recorded bird calls (*d*),(*f*)

(*a*) Hunting and hunting equipment are allowed only on farmland.

(*b*) In District F, no person shall hunt south of the St. Lawrence River and north of the road right-of-way of Route 132 between the western limit of the municipality of Montmagny and the eastern limit of the municipality of Cap-Saint-Ignace.

(*c*) In District F, on the north shore of the St. Lawrence River, no person shall hunt north of the St. Lawrence River and south of a line located at 1000 m north of Highway 40 between Montée St-Laurent and the Maskinongé River. On the south shore of the St. Lawrence River, no person shall hunt south of the St. Lawrence River and north of the railroad right-of-way located near Route 132 between the Nicolet River in the east and Lacerte Road in the west.

(*d*) "Recorded bird calls" refers to bird calls of a species referred to in the heading of column 2.

(*e*) Hunting with bait or in a bait crop area is permitted if the Regional Director has given consent in writing pursuant to section 23.3.

(*f*) Snow Goose call recordings may be used but, if used with decoys, the decoys may only represent white or blue phase Snow Geese, or any combination of them.

MEASURES IN MANITOBA CONCERNING OVERABUNDANT SPECIES

Item	Column 1 Area	Column 2 Period during which Snow Geese may be killed	Column 3 Additional hunting method or equipment
1.	Zone 1	April 1 to May 31 and August 15 to August 31	Recorded bird calls (*a*),(b)
2.	Zones 2, 3, and 4	April 1 to May 31	Recorded bird calls (*a*),(b)

(*a*) "Recorded bird calls" refers to bird calls of a species referred to in the heading of column 2.
(b) Snow Goose call recordings may be used but, if used with decoys, the decoys may only represent white or blue phase Snow Geese, or any combination of them.

MEASURES IN SASKATCHEWAN CONCERNING OVERABUNDANT SPECIES

Item	Column 1 Area	Column 2 Period during which Snow Geese may be killed	Column 3 Additional hunting method or equipment
1.	East of 106° W Longitude	April 1 to May 31	Recorded bird calls (*a*),(b)
2.	West of 106° W Longitude	April 1 to April 30	Recorded bird calls (*a*),(b)

(*a*) "Recorded bird calls" refers to bird calls of a species referred to in the heading of column 2.
(*b*) Snow Goose call recordings may be used but, if used with decoys, the decoys may only represent white or blue phase Snow Geese, or any combination of them.

MEASURES IN NUNAVUT CONCERNING OVERABUNDANT SPECIES

Item	Column 1 Area	Column 2 Period during which Snow Geese may be killed	Column 3 Additional hunting method or equipment
1.	Throughout Nunavut	May 1 to June 7	Recorded bird calls (*a*),(*b*)
2.	Throughout Nunavut	August 15 to August 31	Recorded bird calls (*a*),(*b*)

(*a*) "Recorded bird calls" refers to bird calls of a species referred to in the heading of column 2.
(*b*) Snow Goose call recordings may be used but, if used with decoys, the decoys may only represent white phase Snow Geese or blue phase Snow Geese, or any combination of them.

Figures

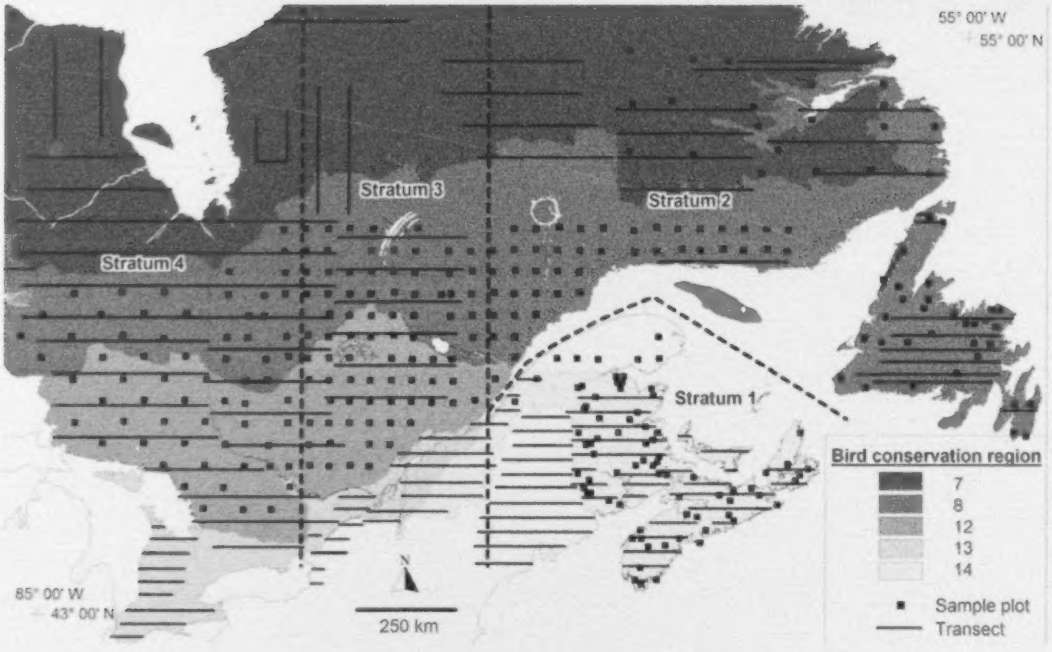


Figure 1. Eastern Waterfowl Survey Area in Eastern Canada
(Source: C. Lepage and M. Melançon)

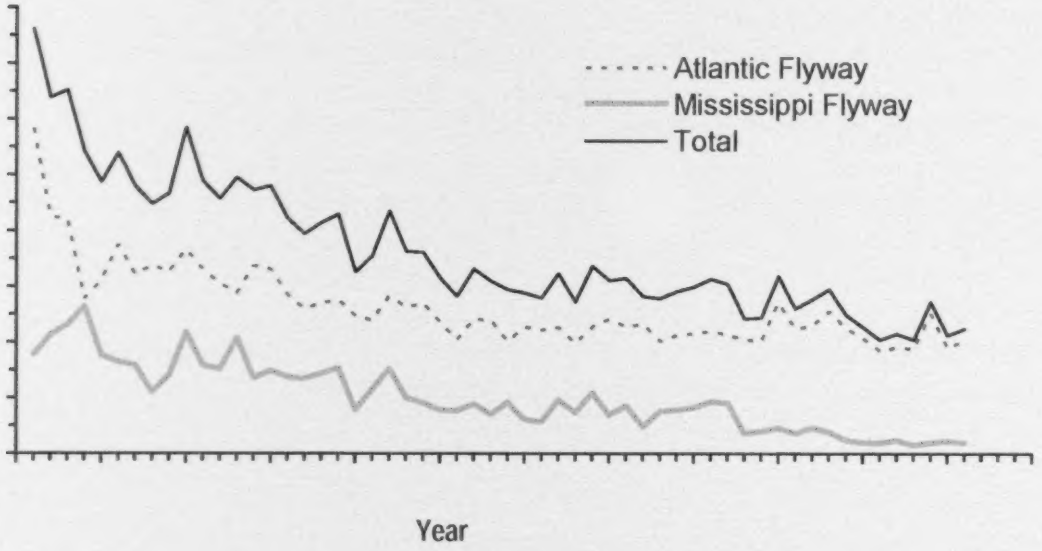


Figure 2. American Black Ducks in the Atlantic and Mississippi Flyways in Mid-winter
Survey results in the Atlantic Flyway for 2001 and in the Mississippi Flyway for 1993 and 1998 were incomplete in some states.

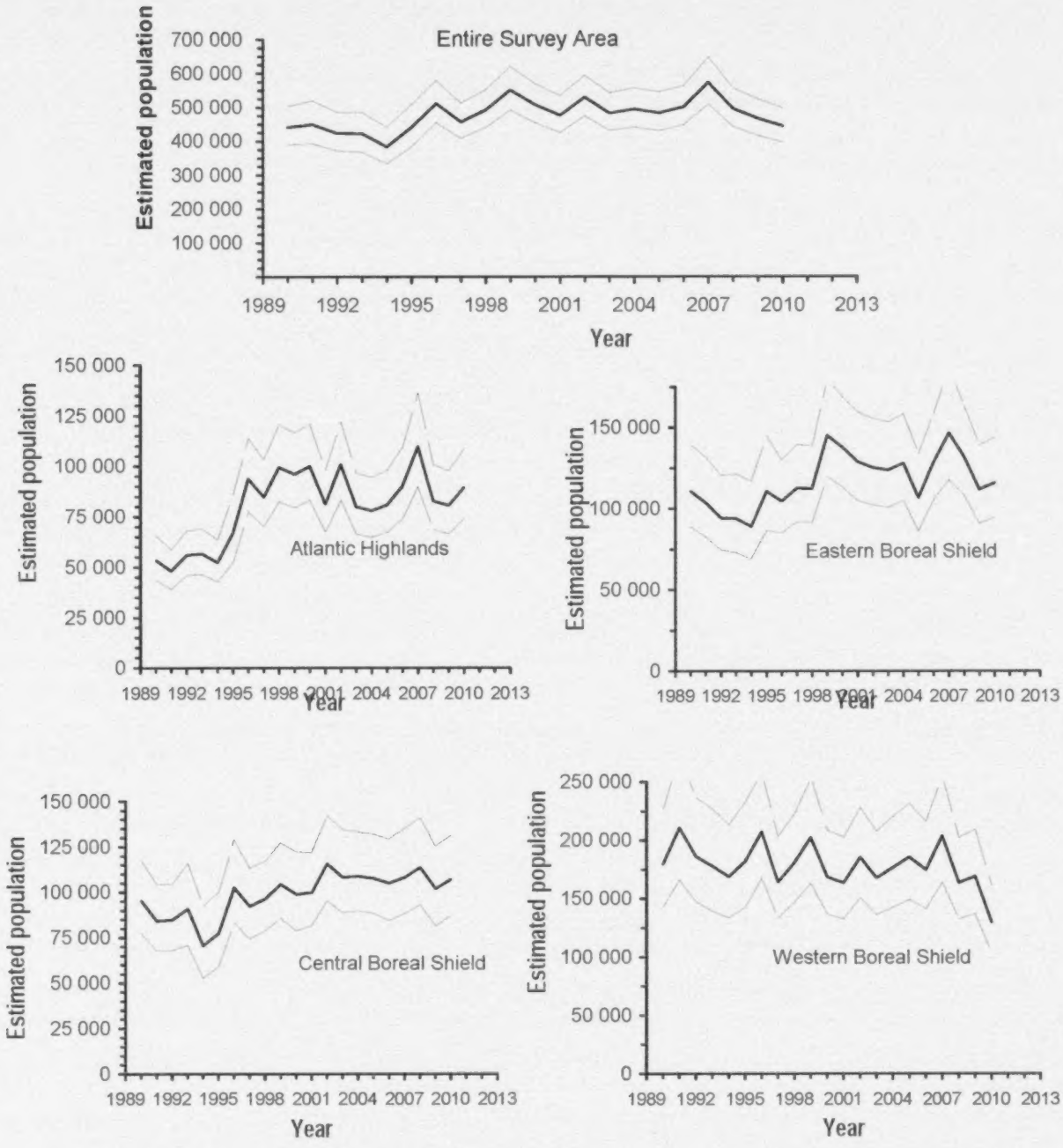


Figure 3. American Black Ducks in the Eastern Waterfowl Survey area
Estimated number of indicated birds, with 95% confidence limits. The figures represent the combined results of helicopter and fixed-wing aircraft surveys.

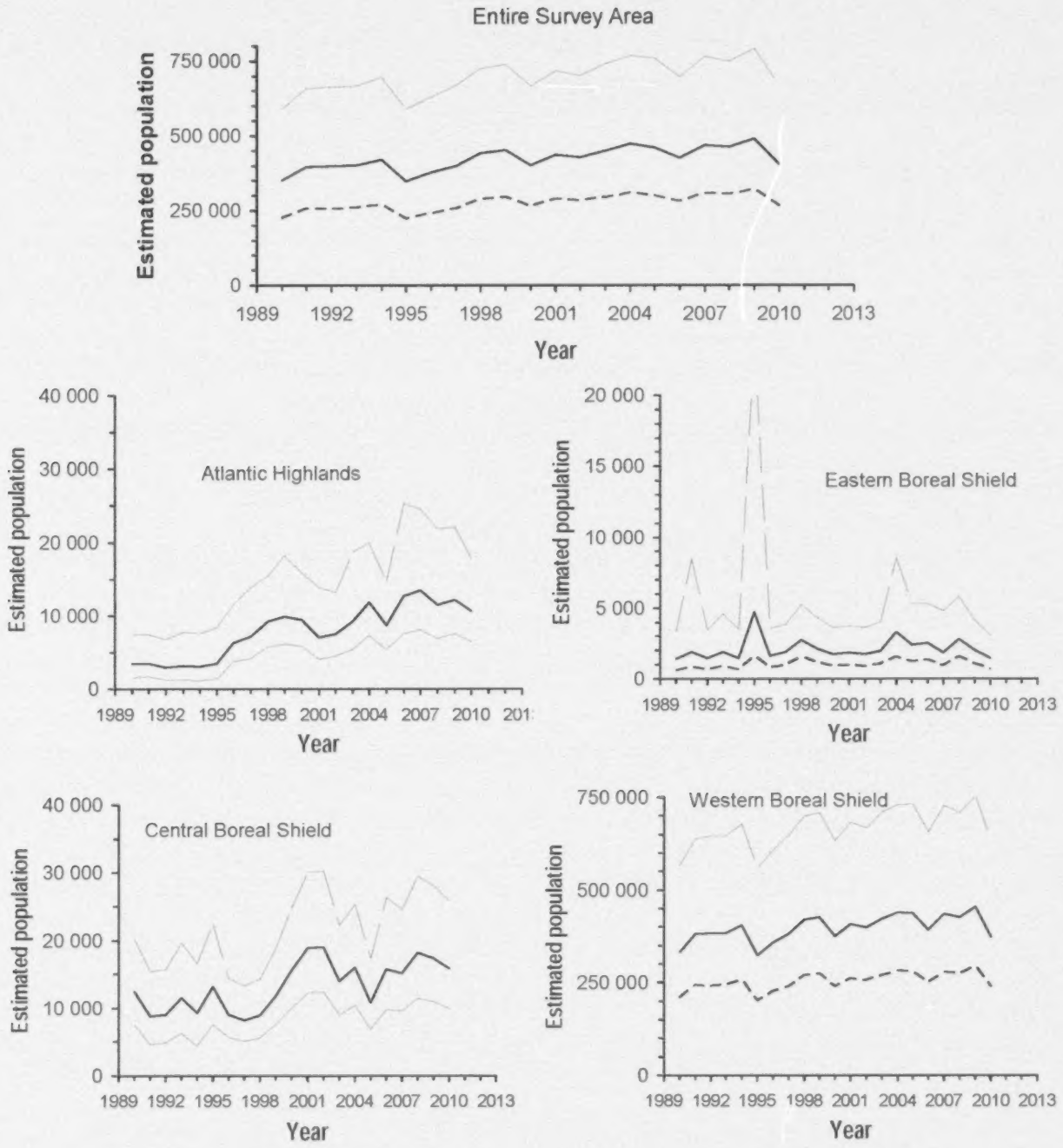


Figure 4a. Mallards in the Eastern Waterfowl Survey area

Estimated number of indicated birds, with 95% confidence limits. The figures represent the combined results of helicopter and fixed-wing aircraft surveys.

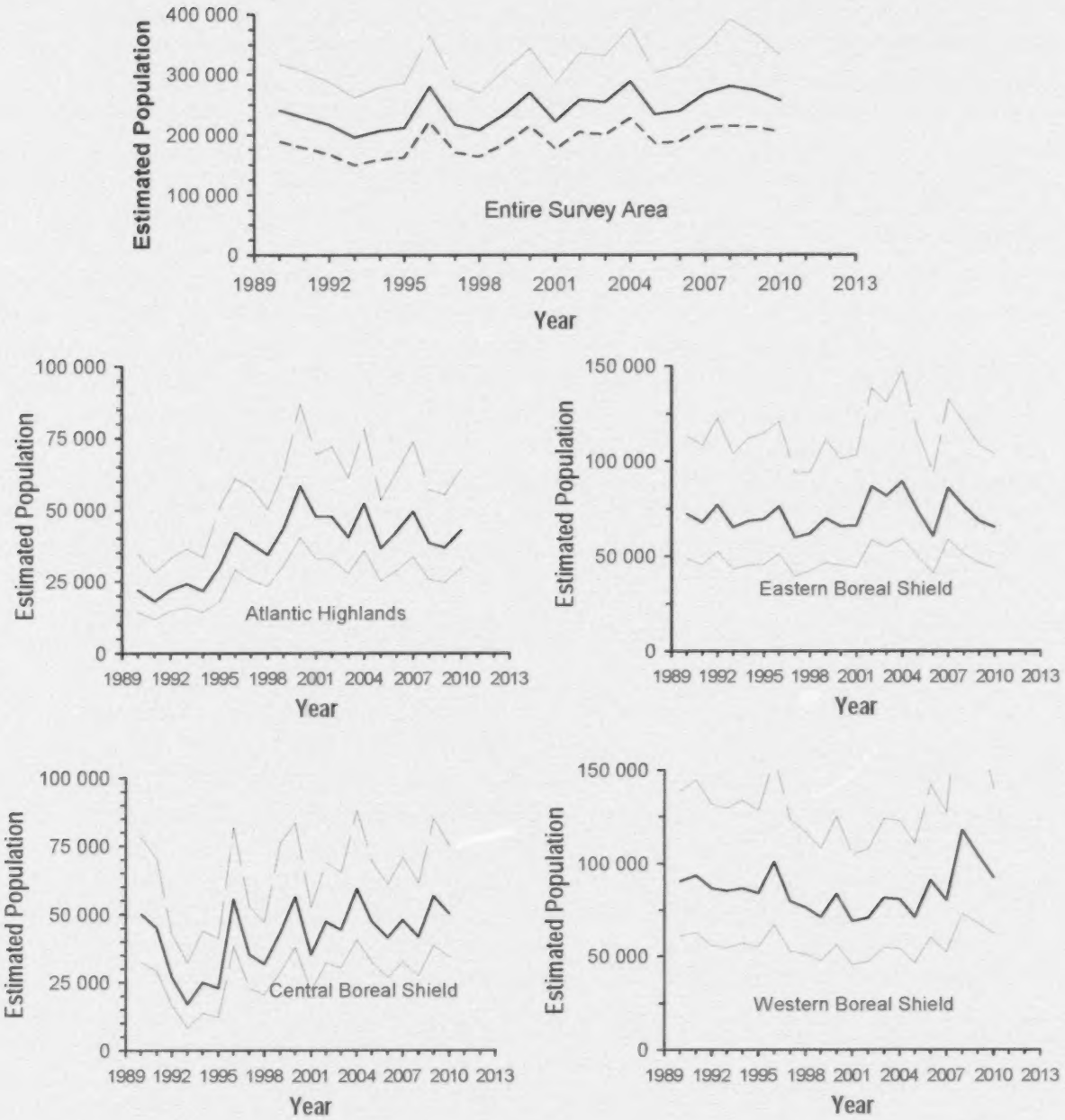


Figure 4b. American Green-winged Teal in the Eastern Waterfowl Survey area
Estimated number of indicated birds, with 95% confidence limits. The figures represent the combined results of helicopter and fixed-wing aircraft surveys.

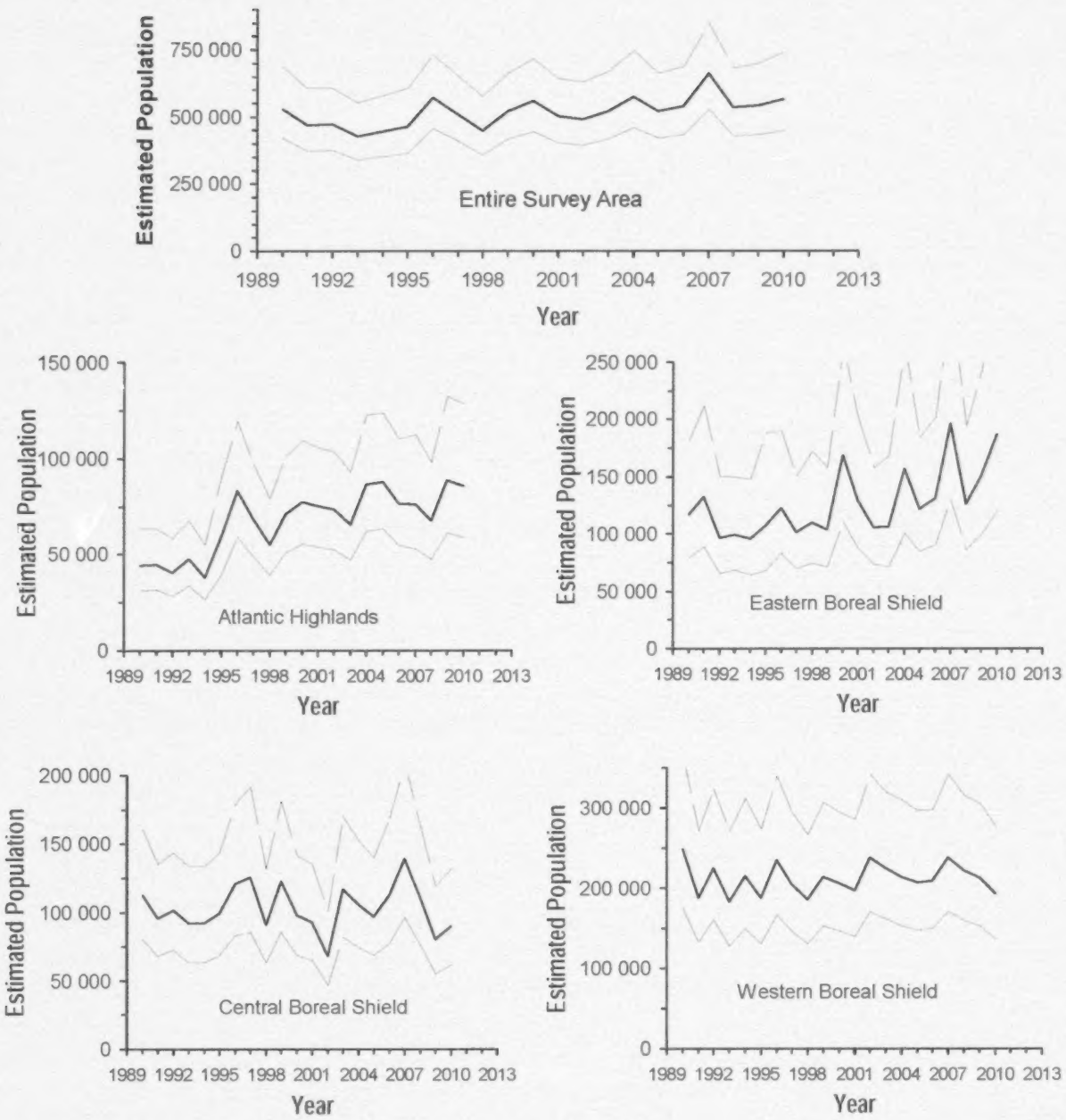


Figure 4c. Ring-necked Ducks in the Eastern Waterfowl Survey area

Estimated number of indicated birds, with 95% confidence limits. The figures represent the combined results of helicopter and fixed-wing aircraft surveys.

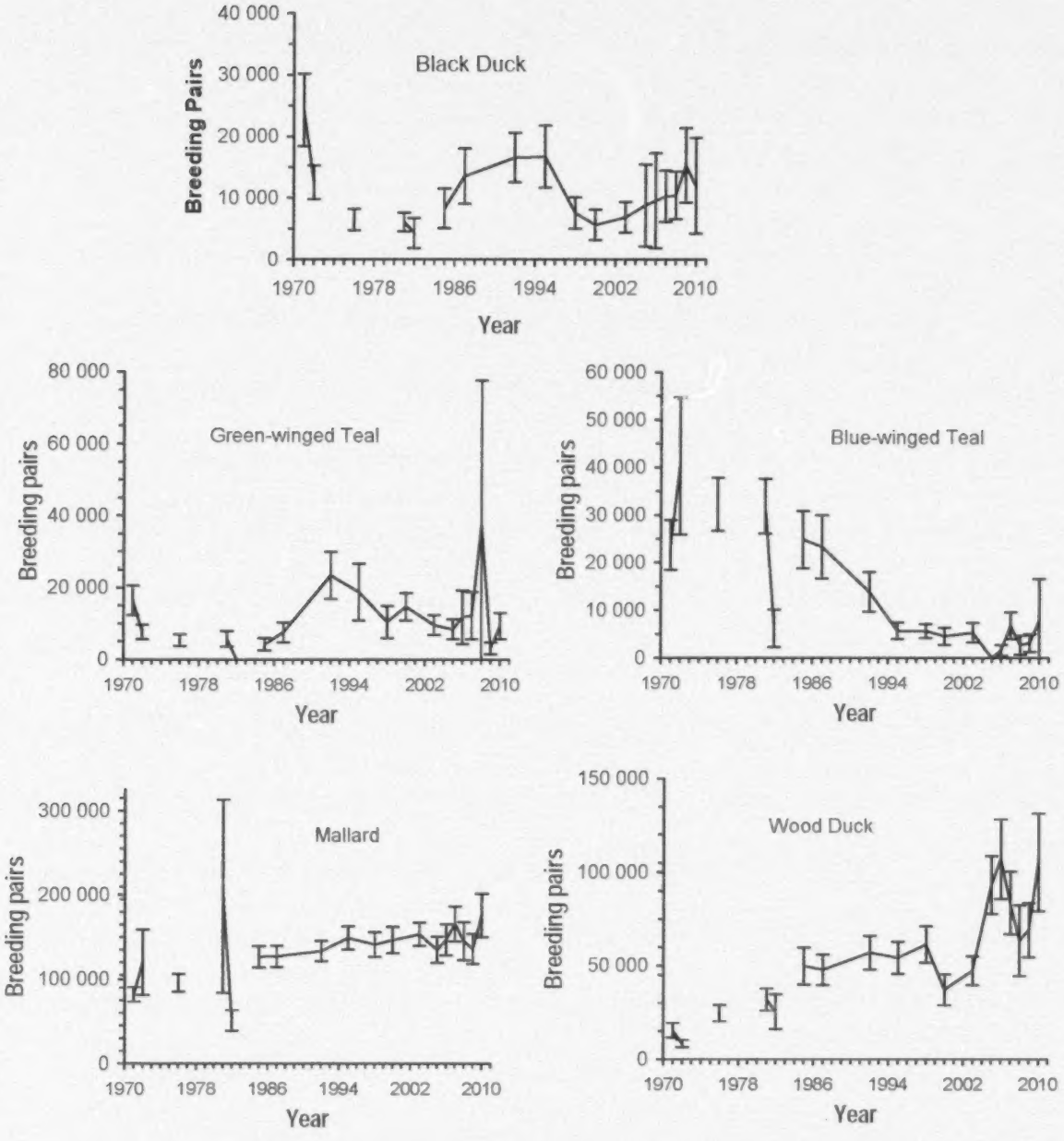
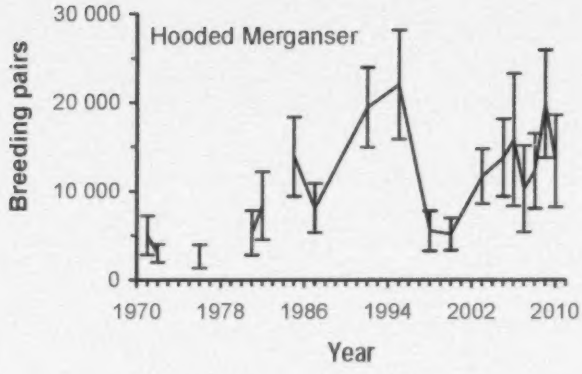
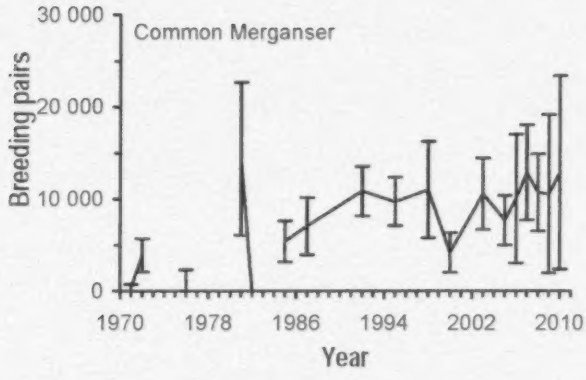


Figure 5a. Estimated Breeding Pairs (±1 SE) of Dabbling duck species in Southern Ontario, based on ground survey plots, 1971–2010
(Source: S. Meyer, CWS, Ontario Region)





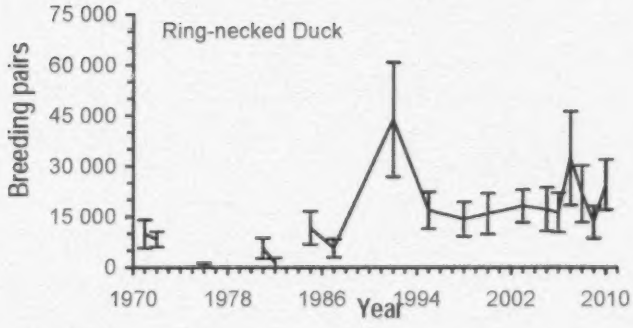


Figure 5b. Estimated Breeding Pairs (±1 SE) of Diving duck species in Southern Ontario, based on ground plots, 1971–2009
(Source: S. Meyer, CWS, Ontario Region)

Regions of the WBPHS

1.	Strata 1-11	Alaska
2.	Strata 12-25, 50, 75-77	Western Boreal Canada
3.	Strata 26-40	Canadian Prairies
4.	Strata 41-49	U.S. Prairies

Figure 6. Waterfowl Breeding Population and Habitat Survey of Western Canada: Traditional Survey Area of Western Canada and the United States
(Source: U.S. Department of the Interior and Environment Canada)

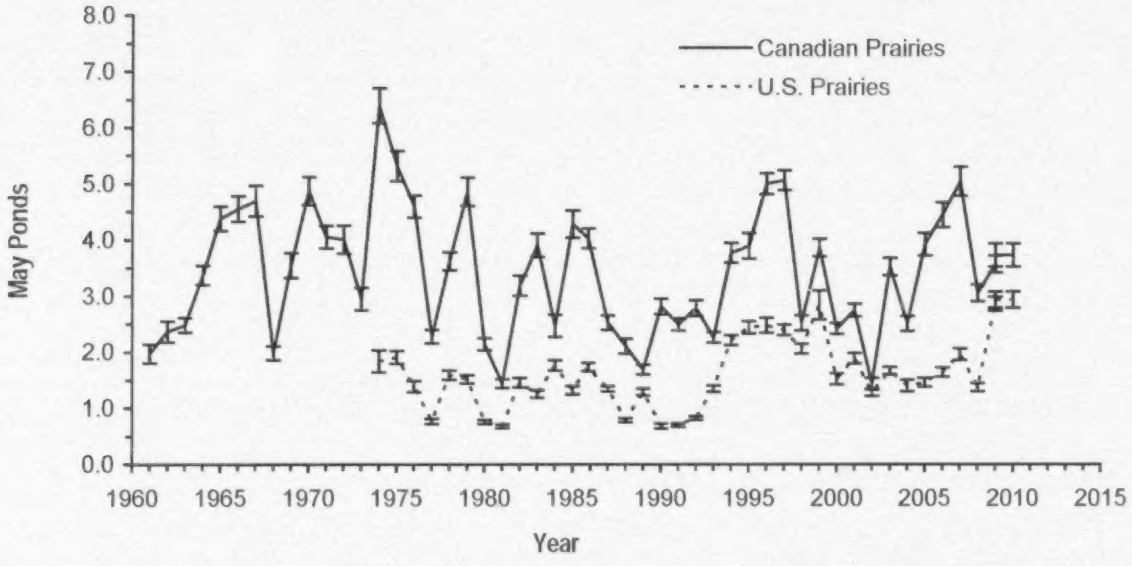


Figure 7. May Ponds in the Canadian and U.S. Prairies
Estimated number of ponds ± 1 SE.

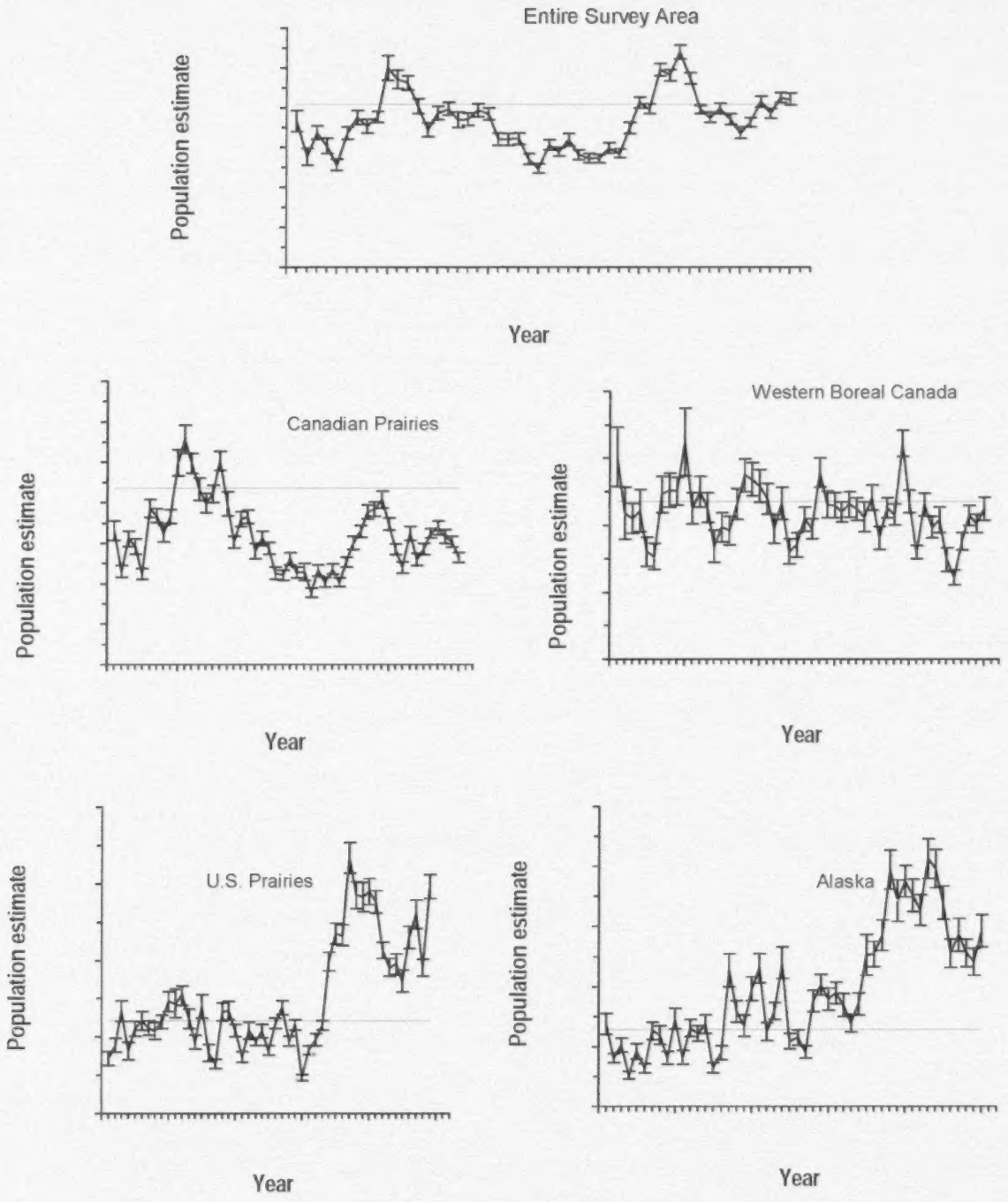


Figure 8. Mallard Breeding Population in the Traditional Survey Area of the Waterfowl breeding Population and Habitat Survey

Data shown are population estimates (±1 SE). The horizontal line represents the NAWMP population goal.

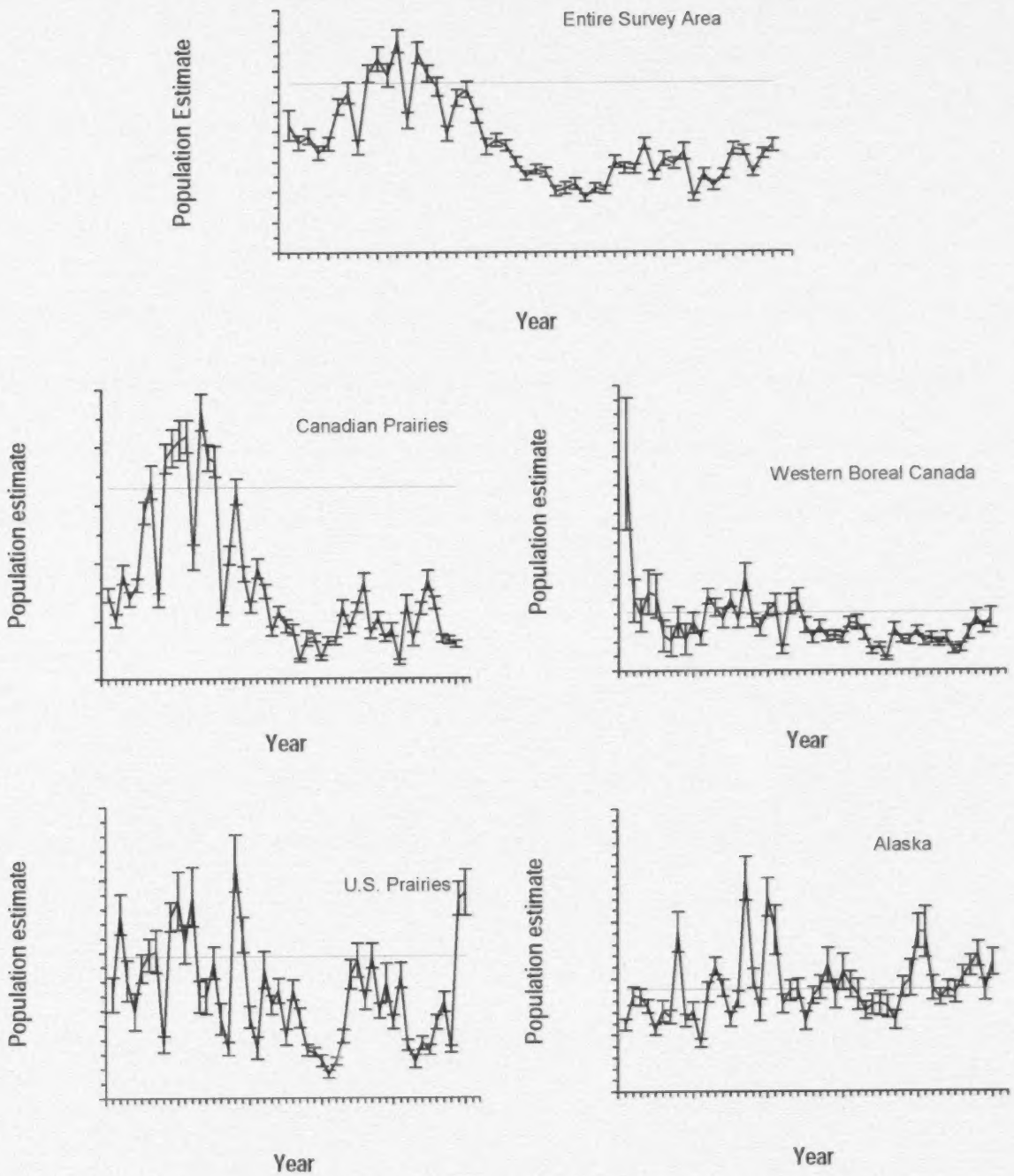


Figure 9. Northern Pintail Breeding Population in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are population estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

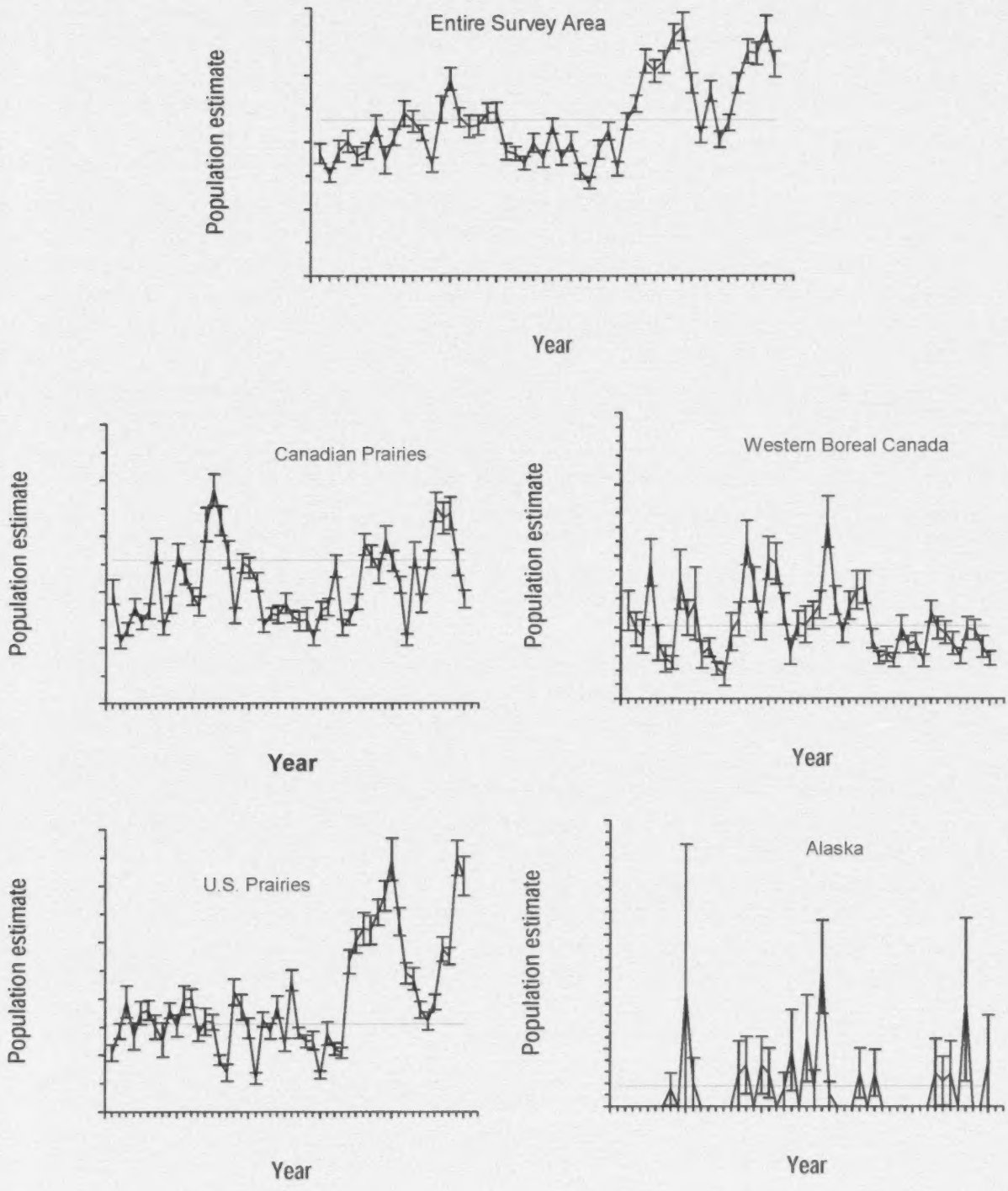


Figure 10. Blue-winged Teal Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are population estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

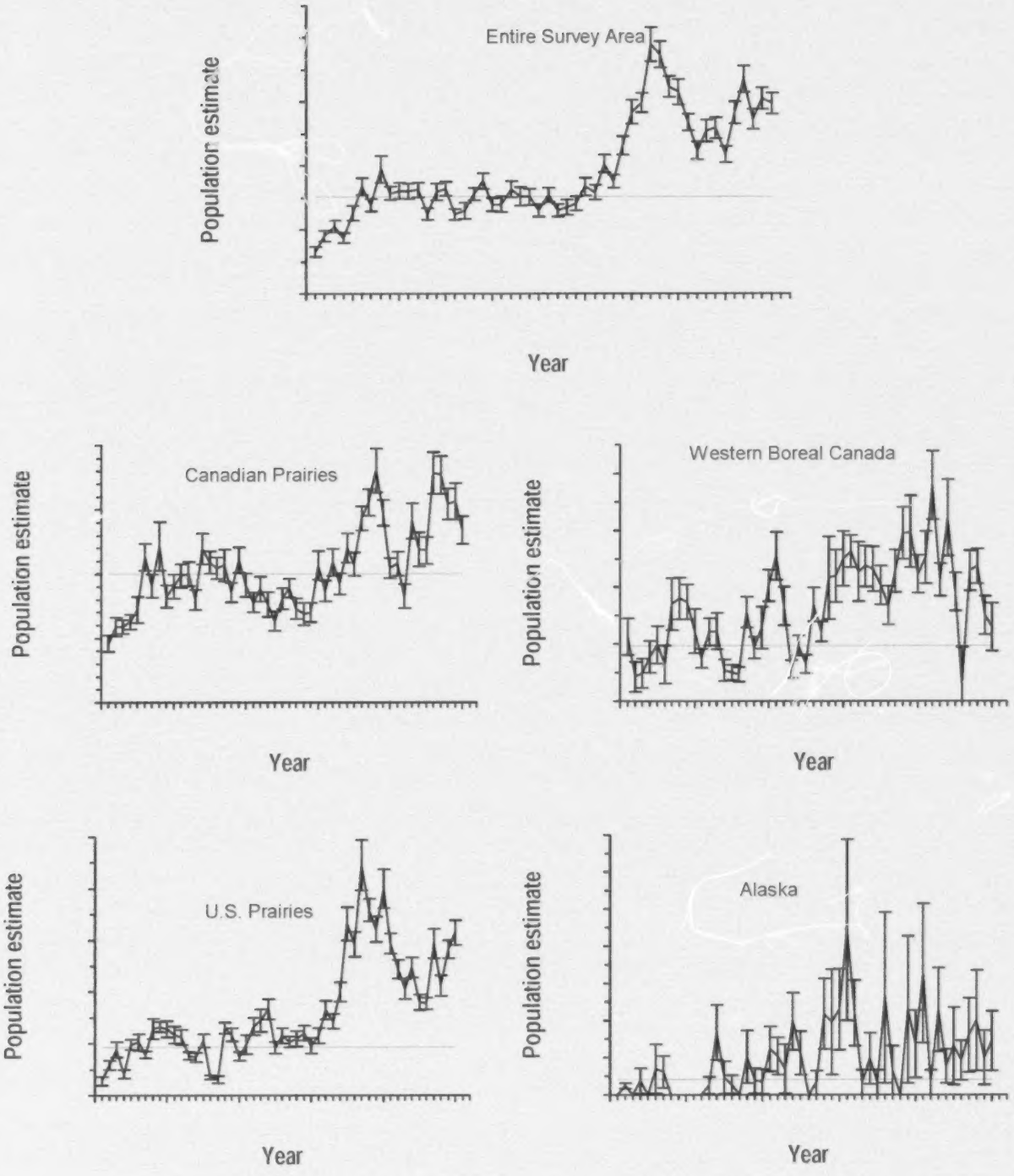


Figure 11. Gadwall Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

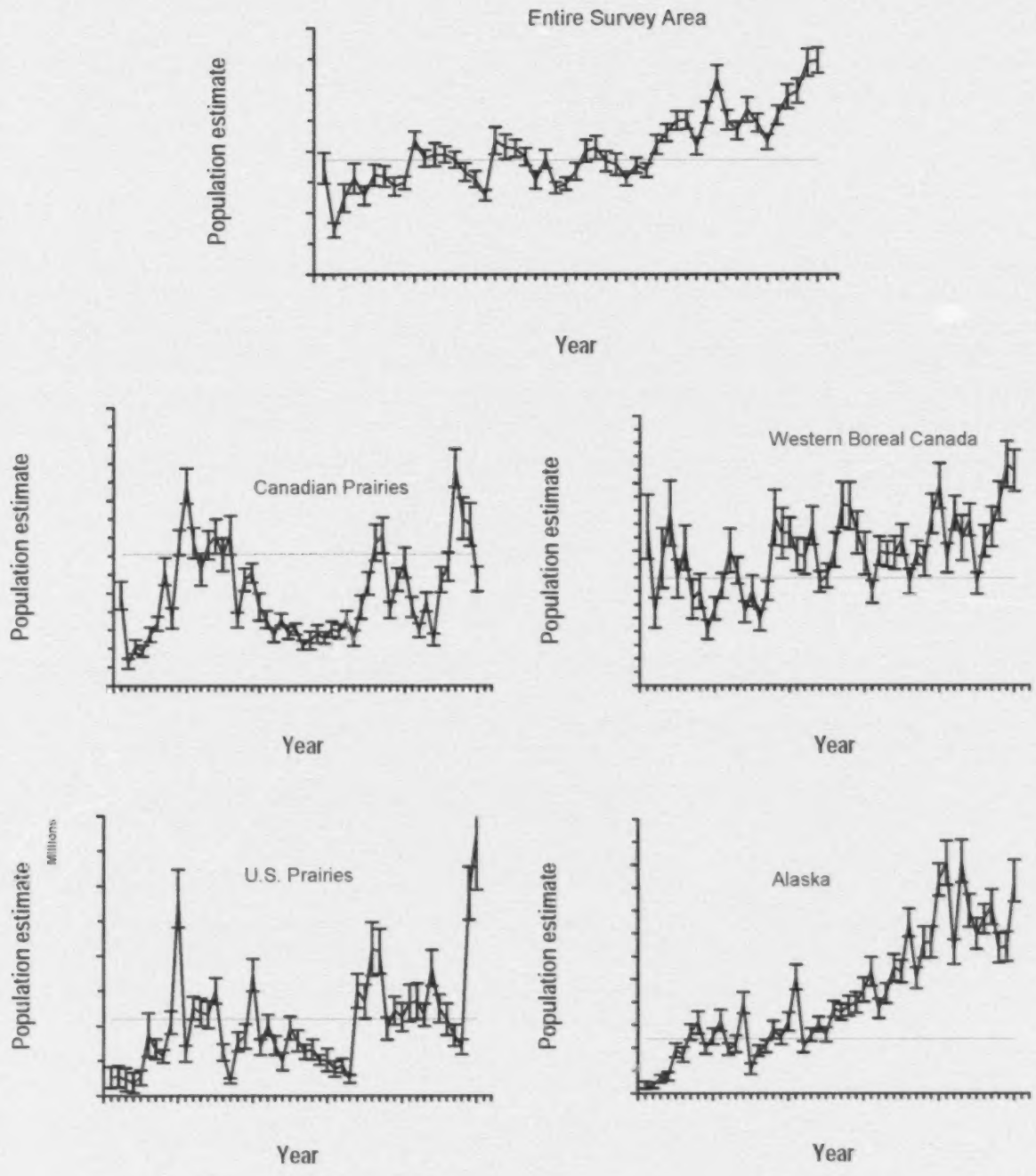


Figure 12. Green-winged Teal Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

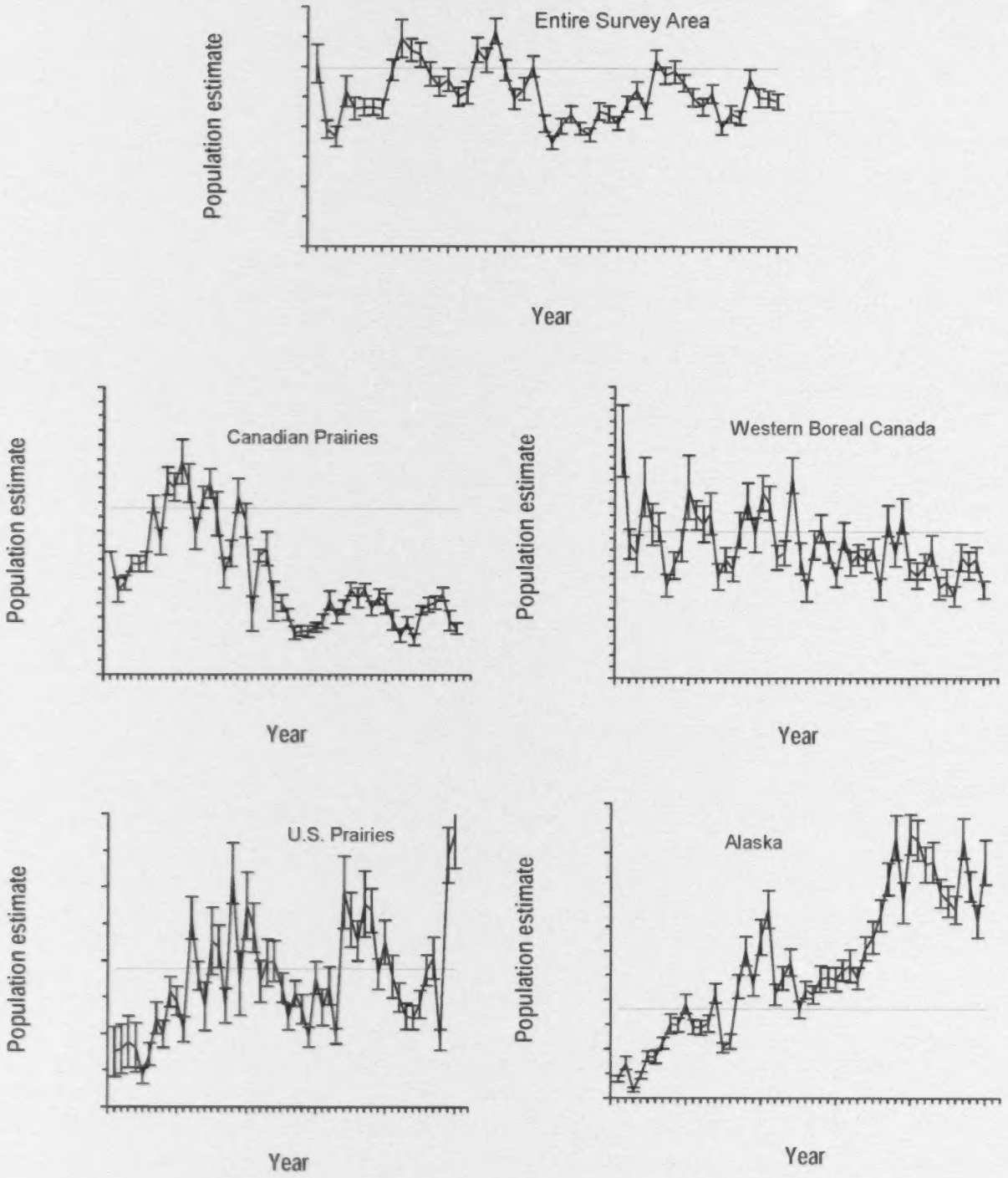


Figure 13. American Wigeon Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

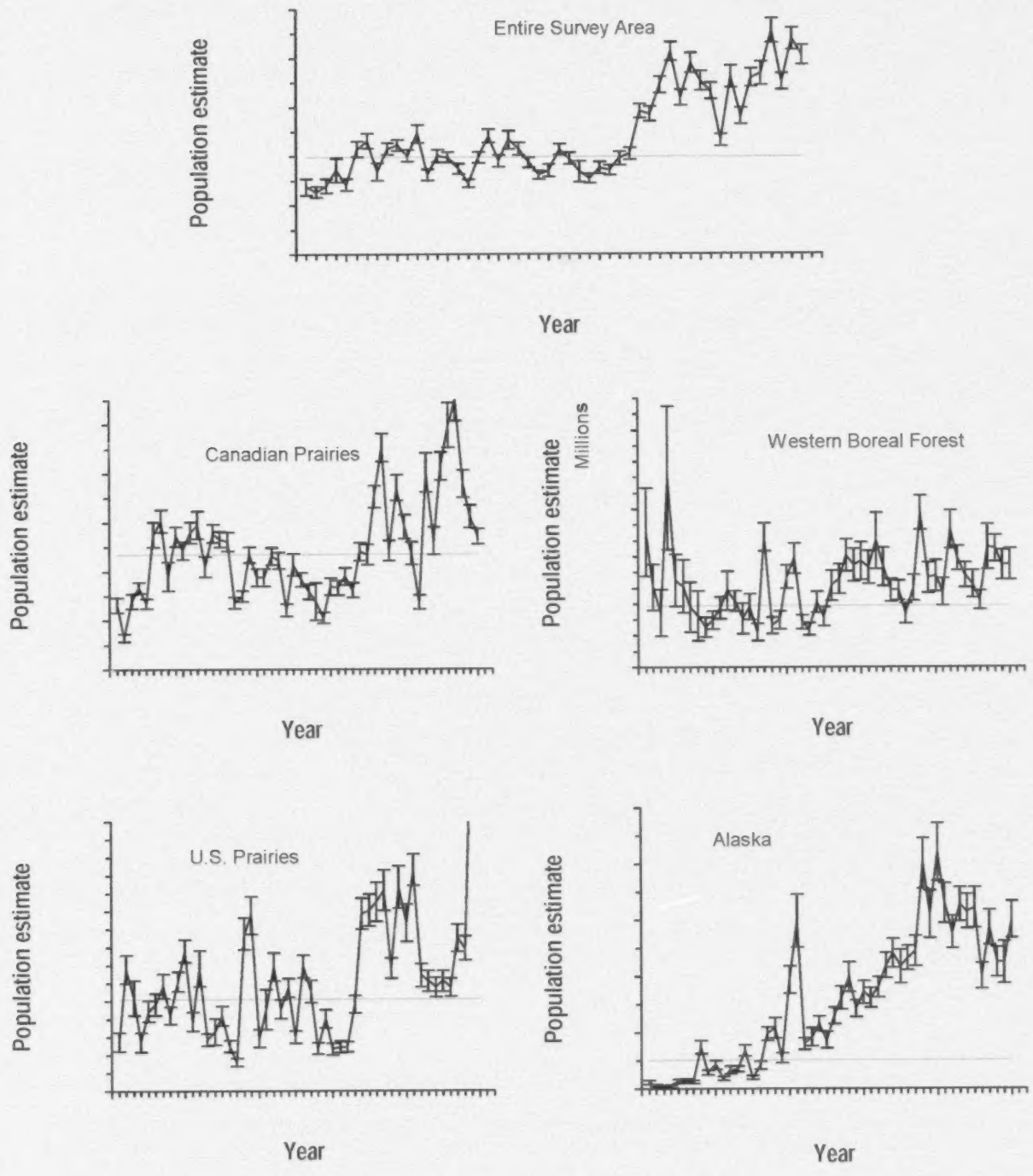


Figure 14. Northern Shoveler Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

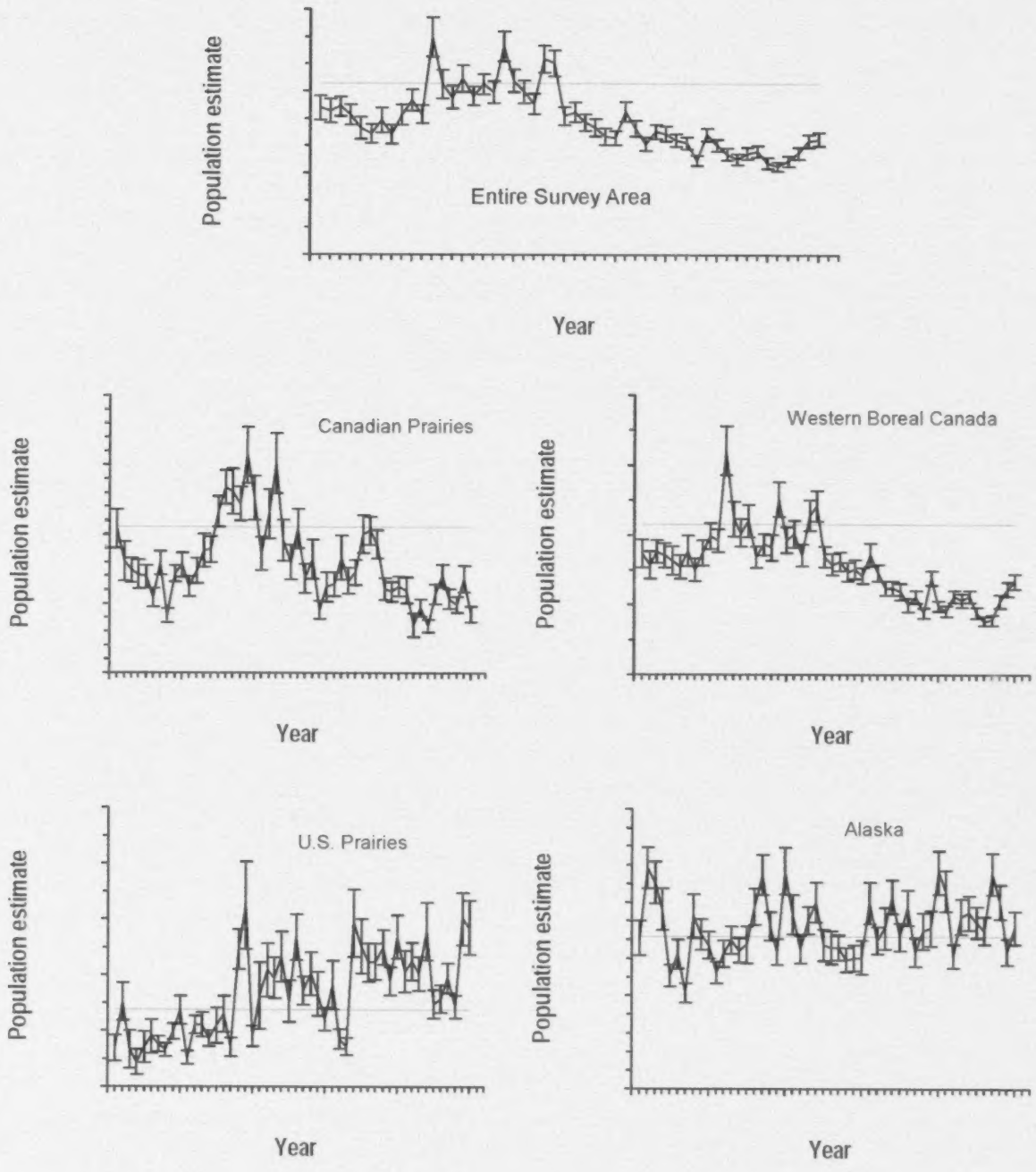


Figure 15. Scaup spp. Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

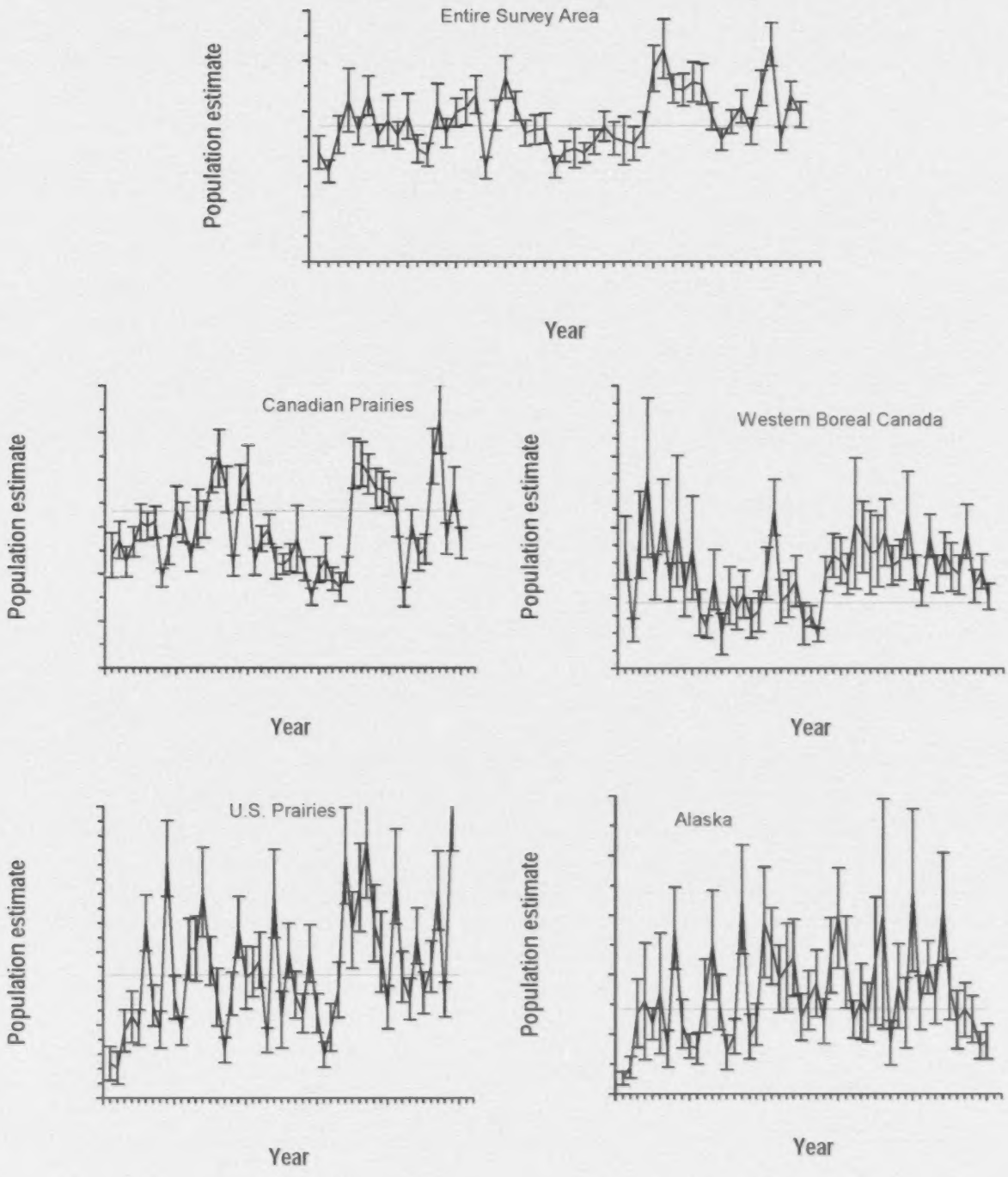


Figure 16. Canvasback Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

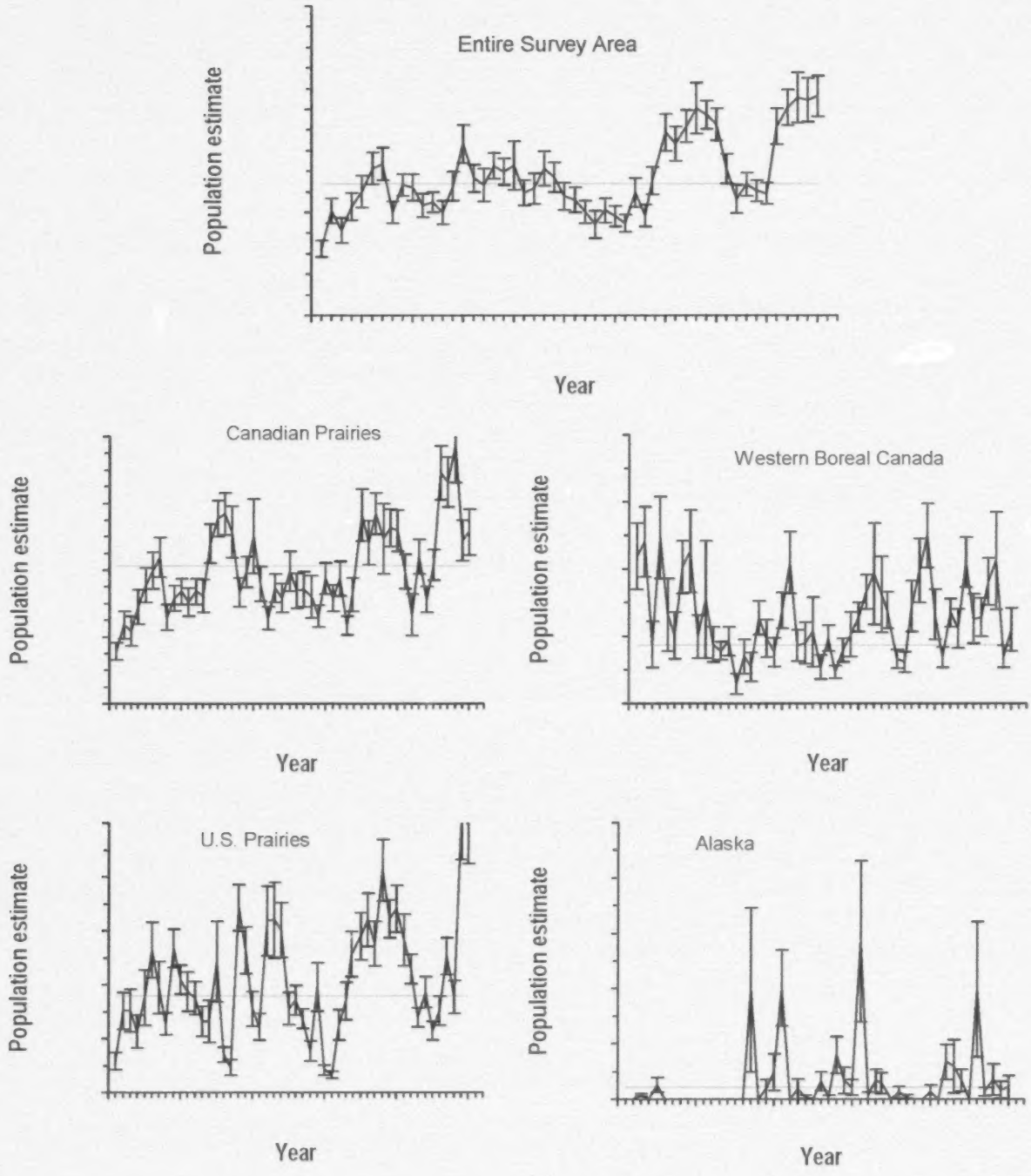


Figure 17. Redhead Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

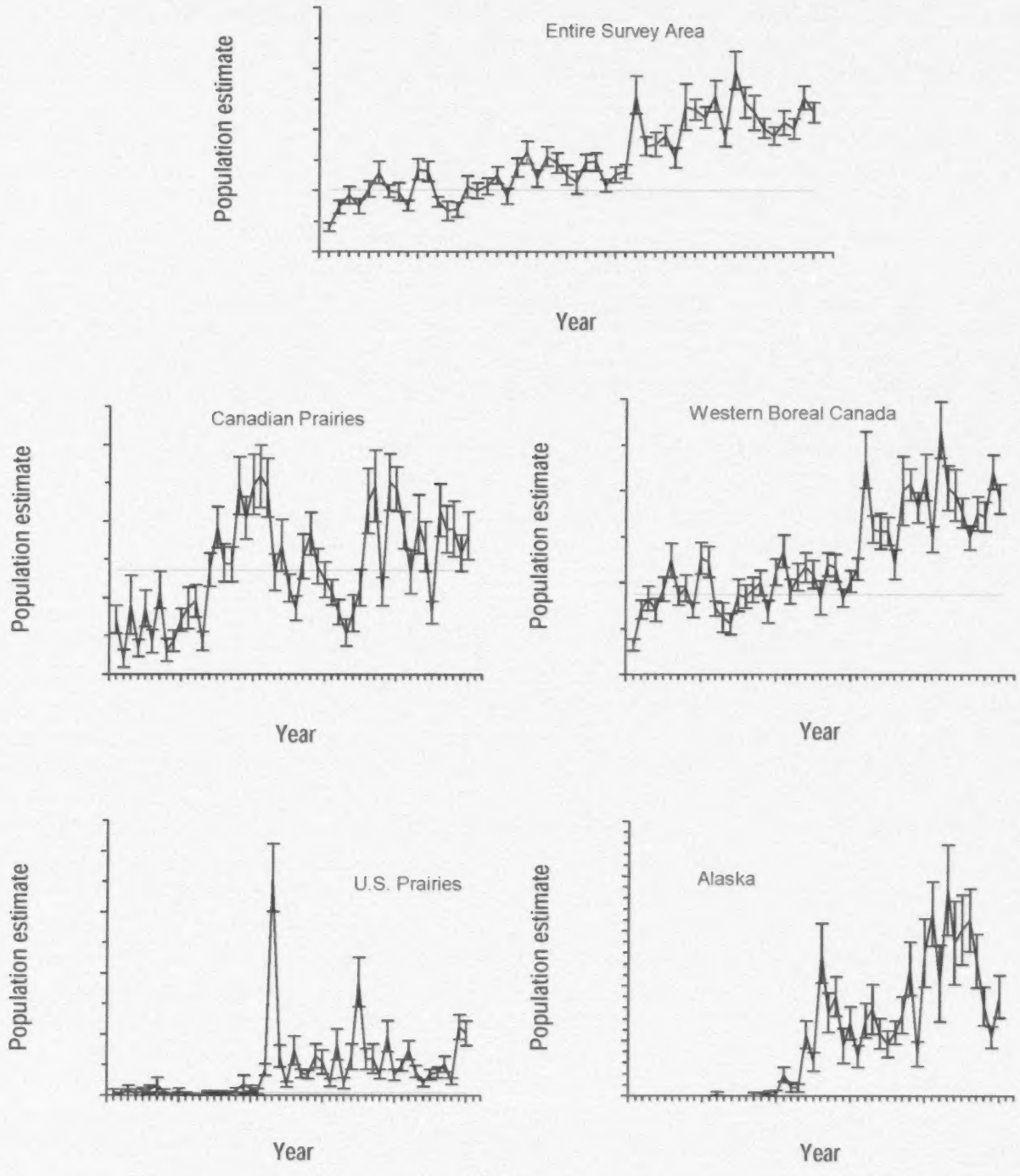


Figure 18. Ring-necked Duck Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

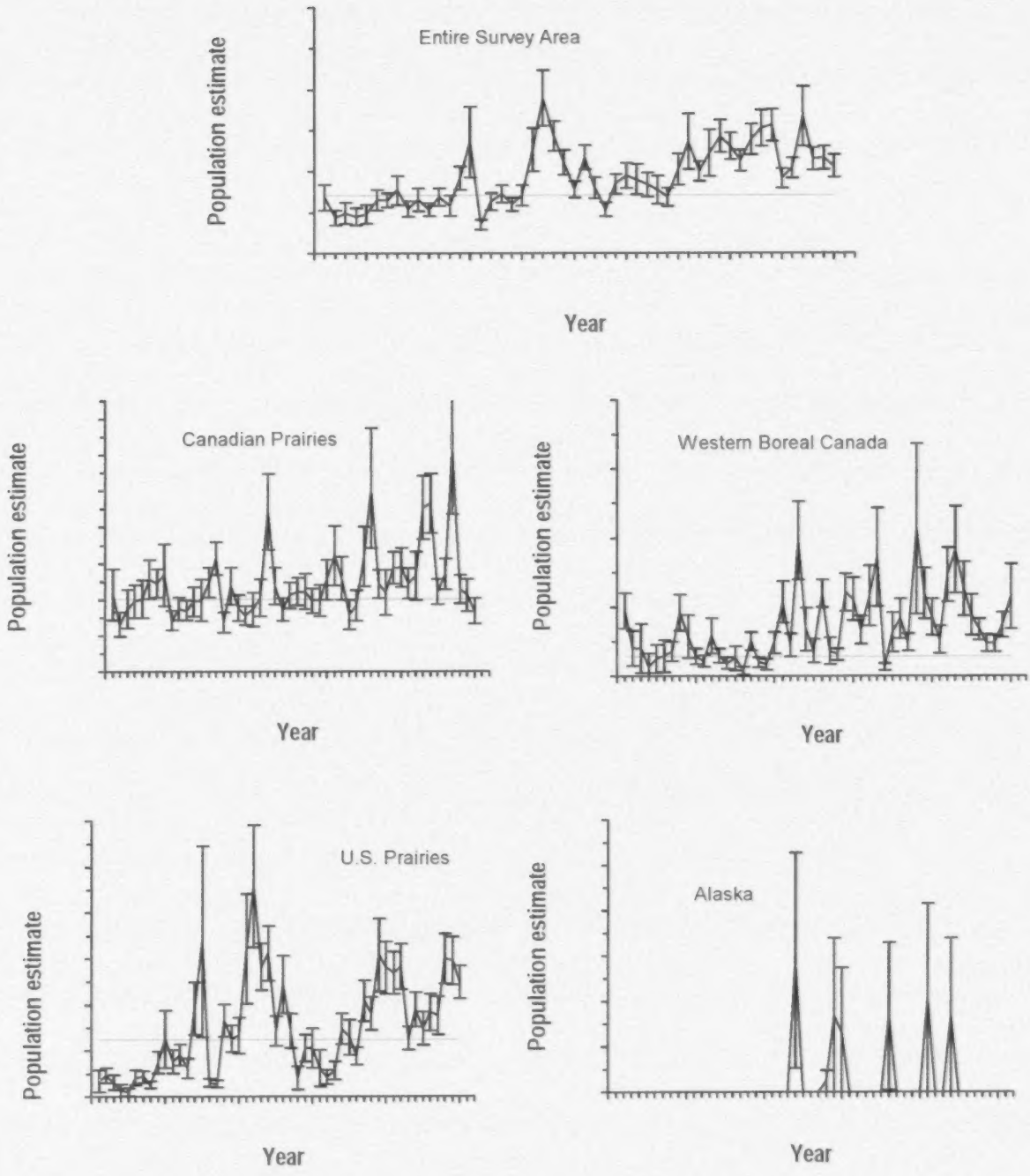


Figure 19. Ruddy Duck Breeding Populations in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

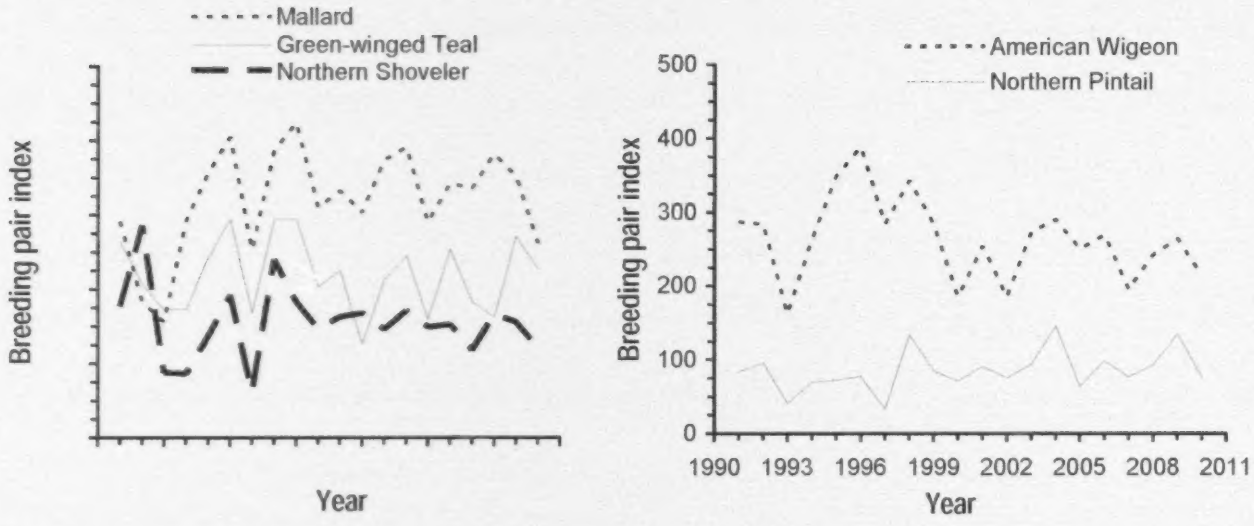


Figure 20. Common Dabbling Ducks in the Southern Yukon
(J. Hawkings, 2010, pers. comm.)

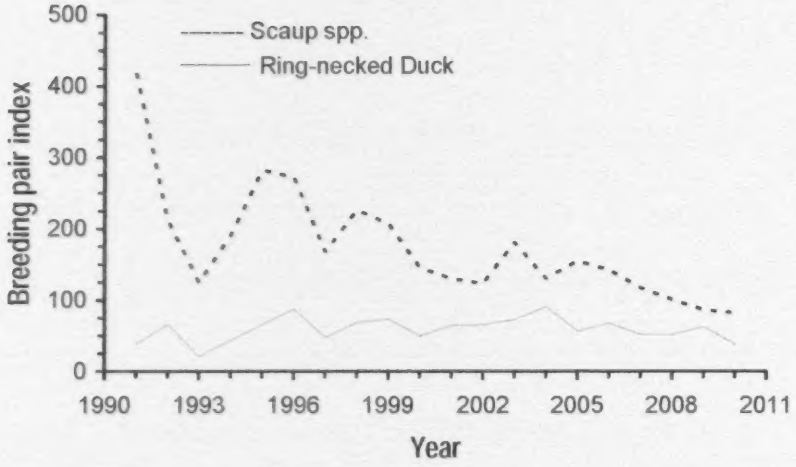


Figure 21. Common Diving Ducks in the Southern Yukon
(J. Hawkings, 2010, pers. comm.)

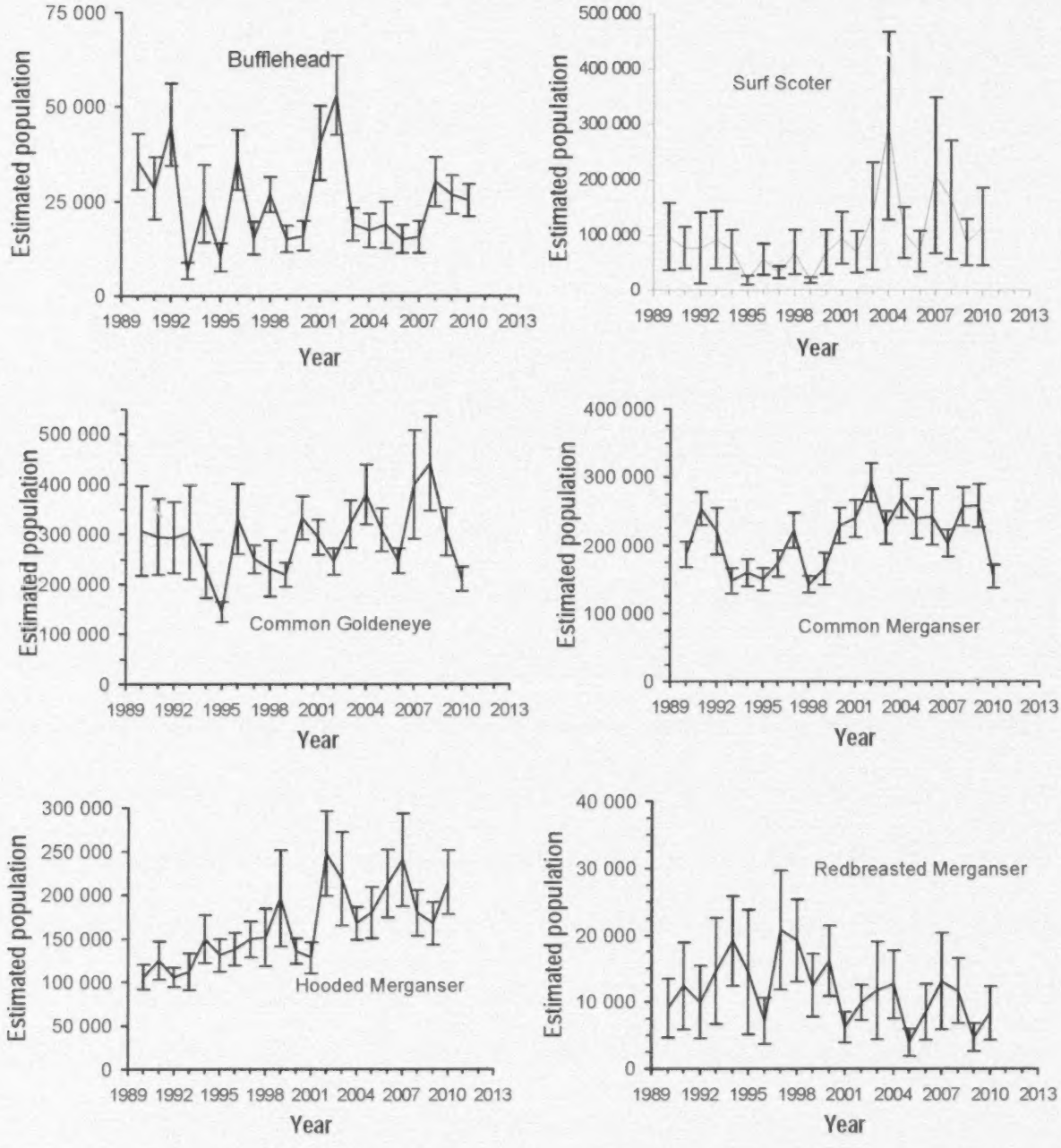


Figure 22. Bufflehead, Surf Scoter, Common Goldeneye, Common Merganser, Hooded Merganser and Redbreasted Merganser in the Eastern Waterfowl Survey area
The figures represent results from the helicopter surveys only (mean and SE).

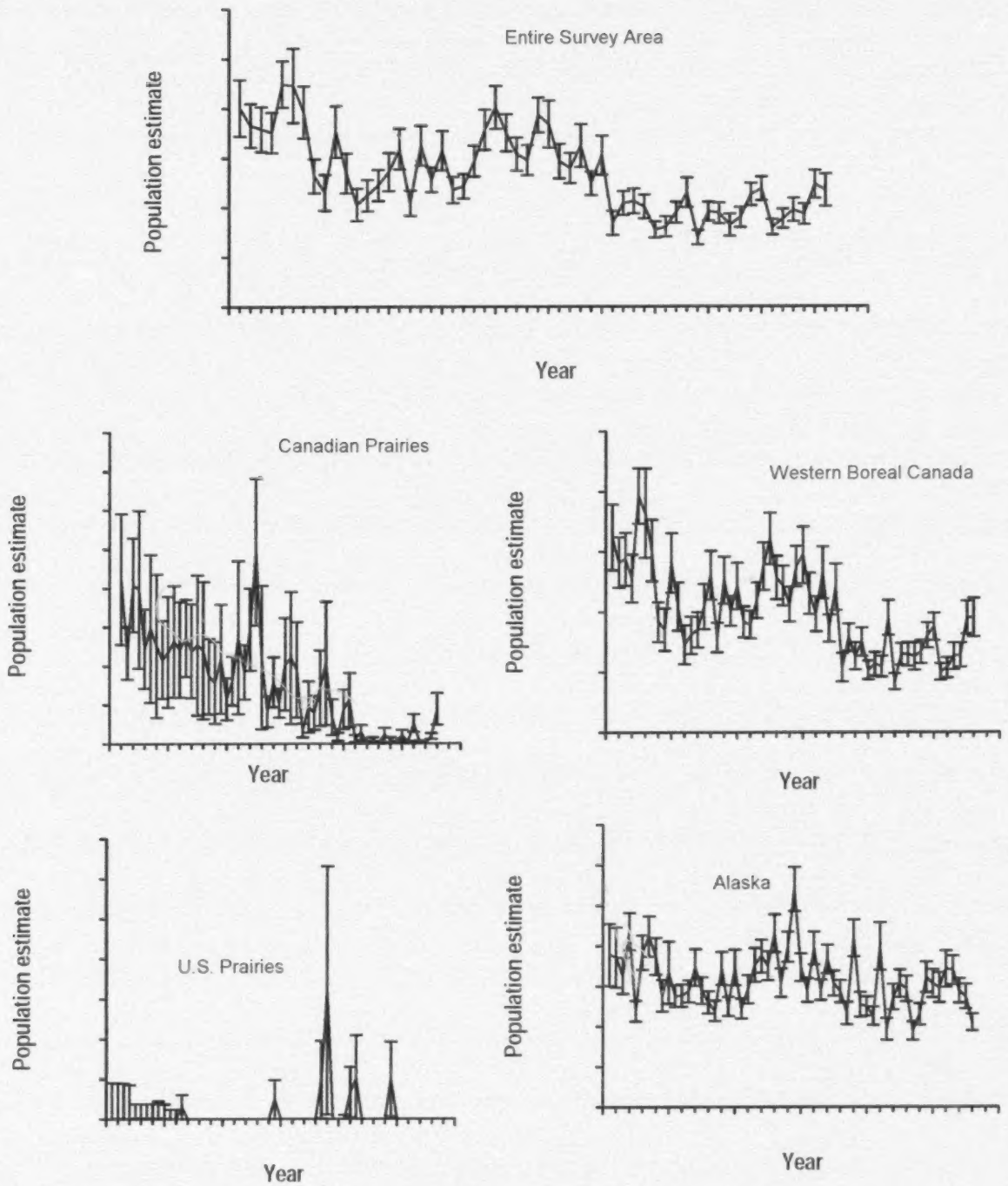


Figure 23. Scoter spp. Breeding Population Estimates in the Traditional Survey Area of the Waterfowl Breeding Population and Habitat Survey

Data shown are population estimates (± 1 SE). The horizontal line represents the NAWMP population goal.

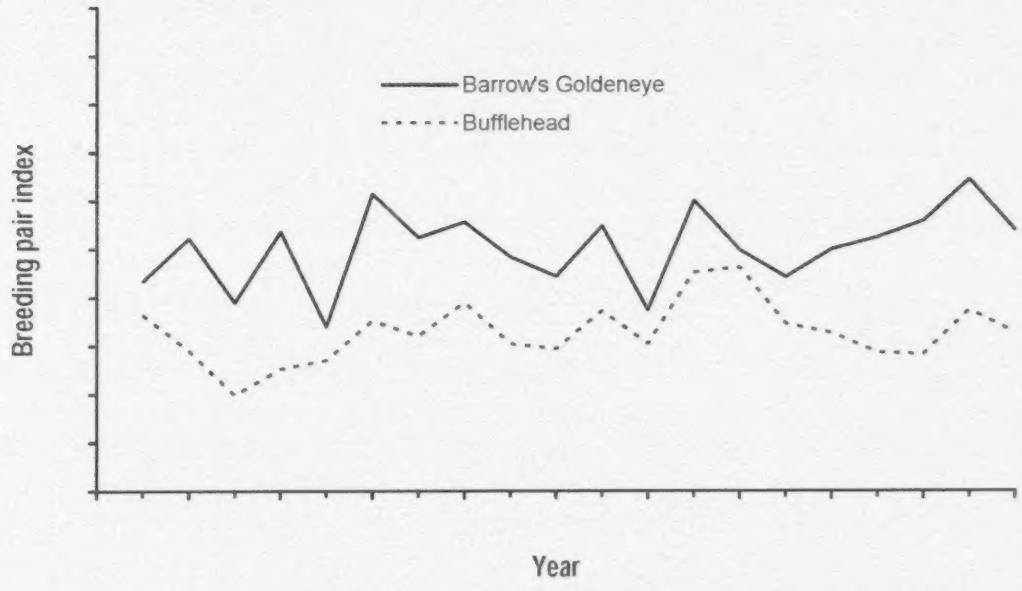


Figure 24. Common Sea Ducks of the Southern Yukon
Trends in indicated breeding pairs (J. Hawkings, 2010, pers. comm.)

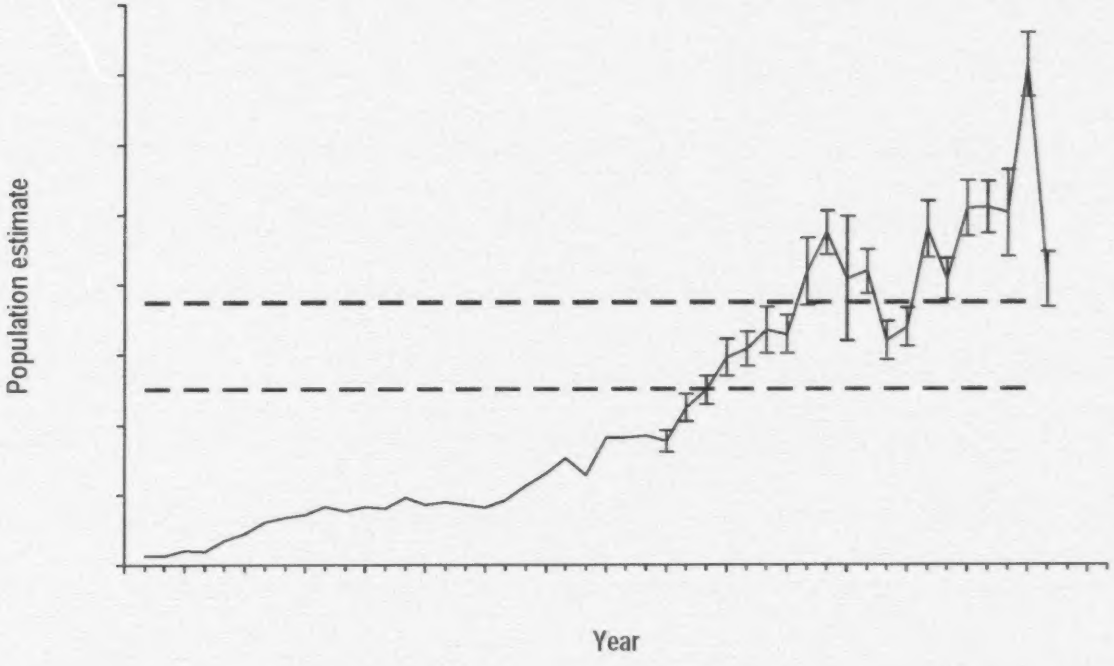


Figure 25. Greater Snow Goose Spring Population in the St. Lawrence River Valley
The horizontal lines represent the target range for the population (Source: Lefebvre 2010).

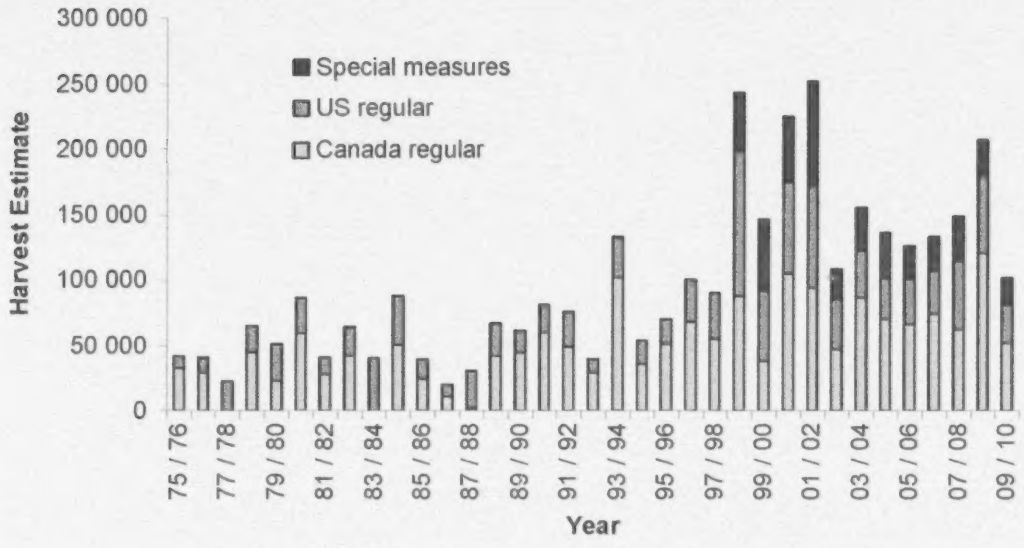


Figure 26. Harvest of Greater Snow Geese

Numbers include geese harvested during special conservation measures initiated in spring 1999.
(Source: Collins and Zimmerling 2010, and Raftovich 2010)

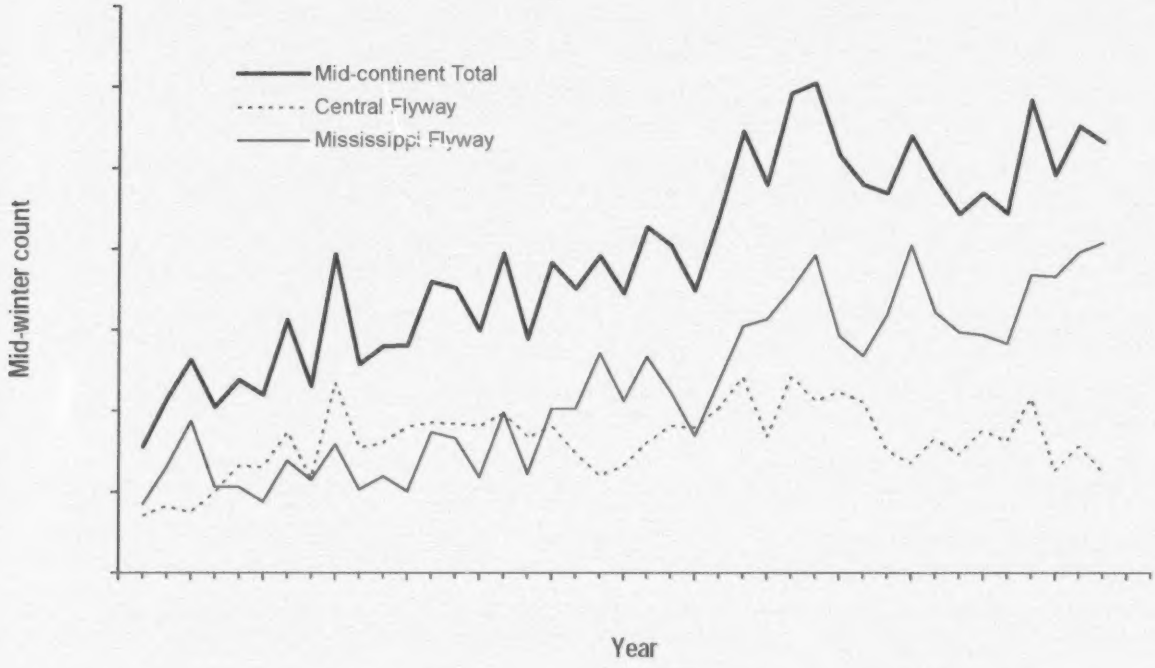


Figure 27. Mid-continent Lesser Snow Geese Populations in Mid-winter

Counts include some Ross' Geese.
(Source: Fronczak, 2010).

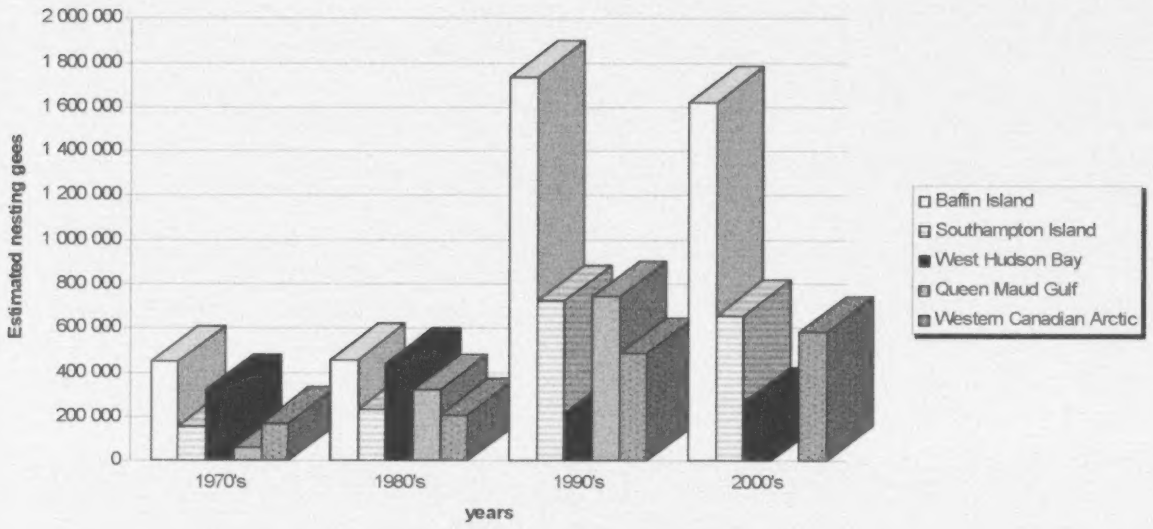


Figure 28. Number of Nesting Lesser Snow Geese Estimated through Photo-inventories of Major Breeding Colonies in Canada

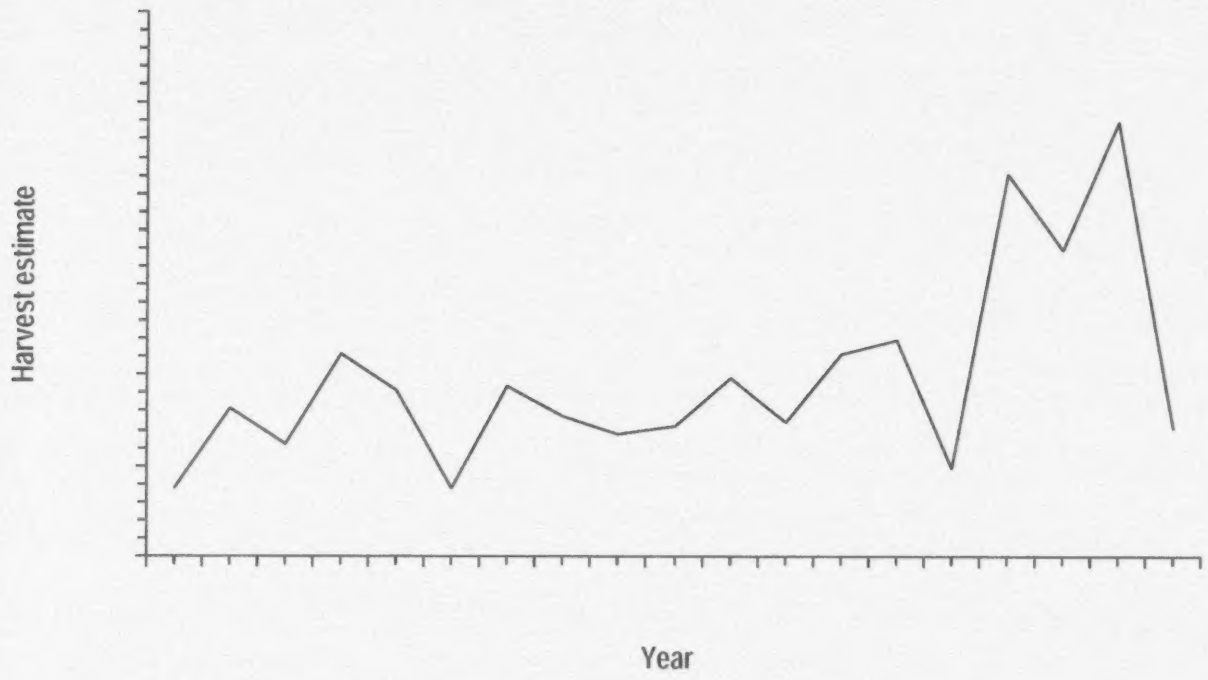


Figure 29. Lesser Snow Geese Harvest Estimates for the Wrangel Island Population
Estimates include adjustment for cripple loss (A. Breault, CWS, unpublished).

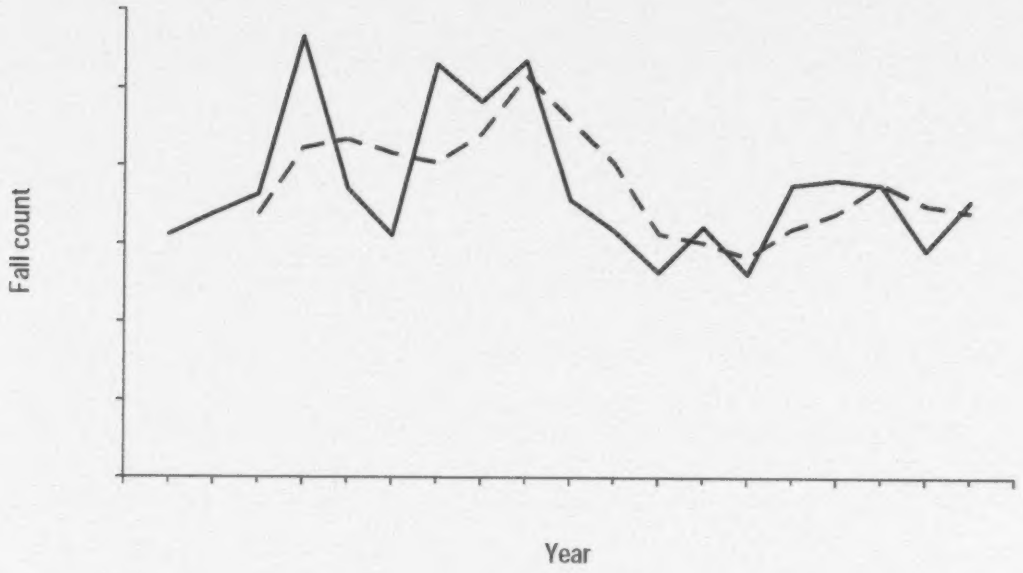
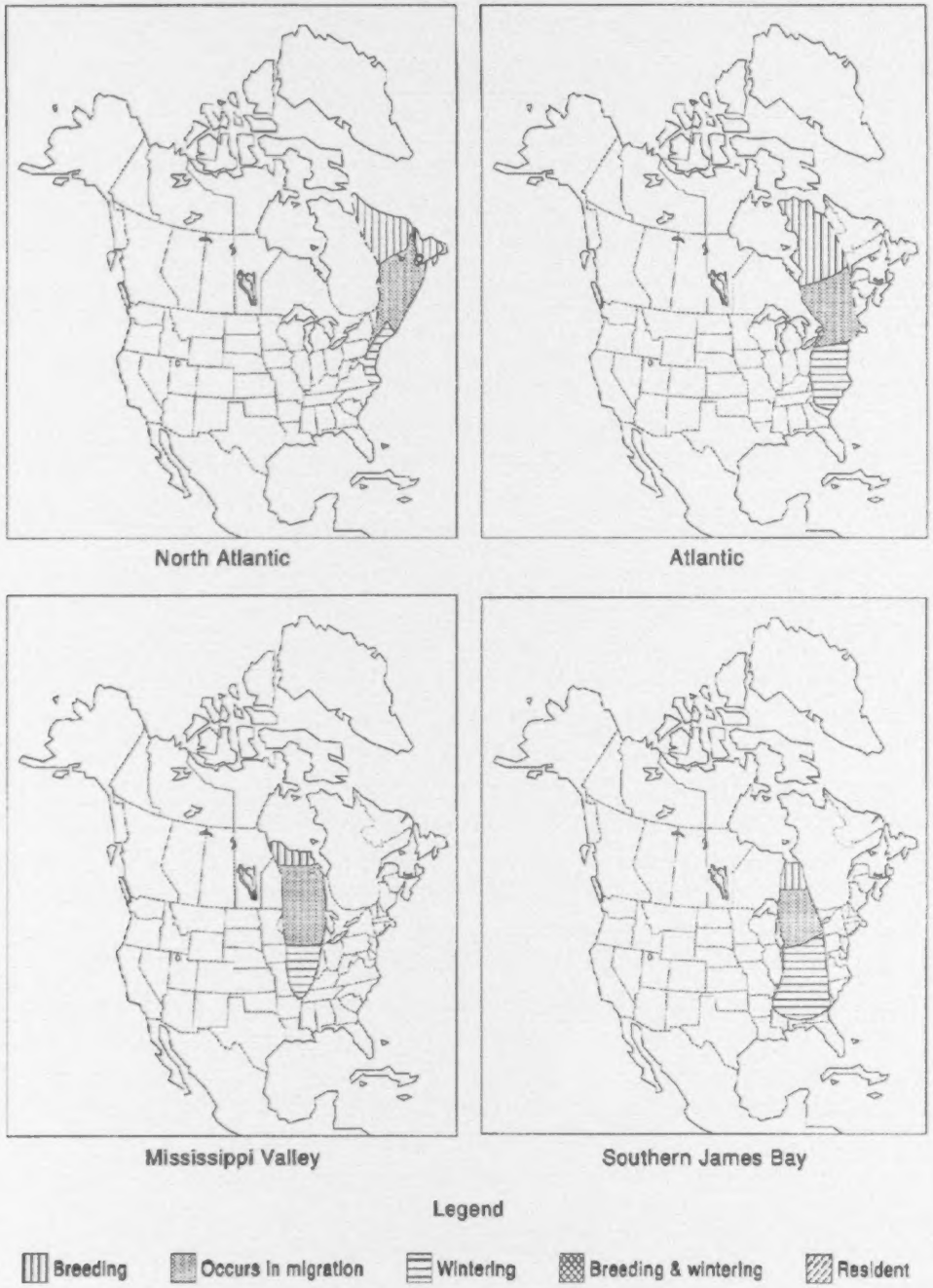


Figure 30. Greater White-fronted Geese of the Mid-Continent

Fall survey on staging areas in Saskatchewan and Alberta (K. Warner, CWS, Prairie and Northern Region). The solid line represents actual counts, and the dashed line represents the running three-year mean.



(from Bellrose 1976, Palmer 1976, Rusch et al. 1996, USFWS 1996)

Figure 31a. Canada Goose Populations in North America: NAP, AP, MVP and SJBP.

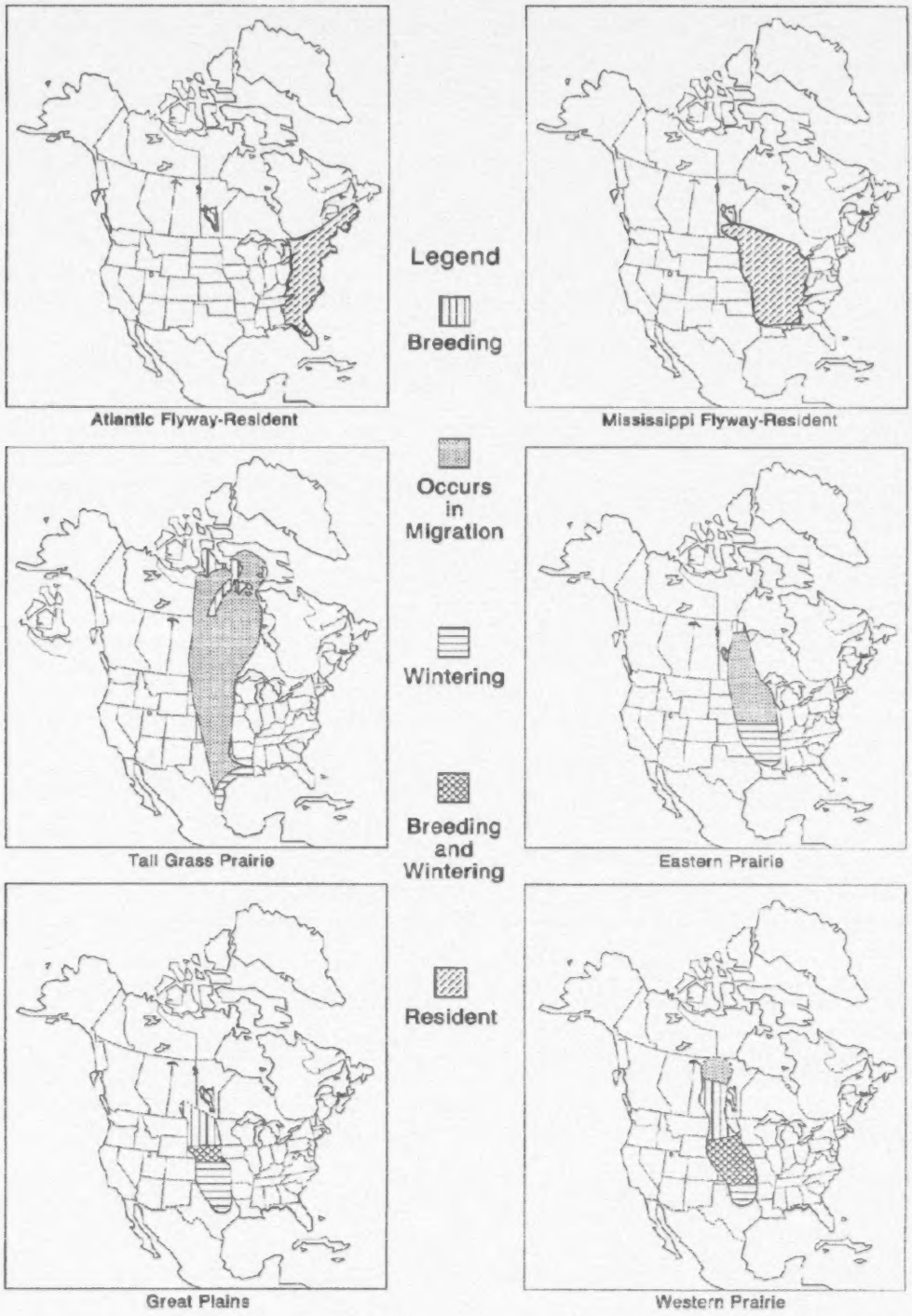


Figure 31b. Canada Goose Populations in North America: AFRP, MFRP, EPP, GPP and WPP. Cackling Goose Population: TGPP

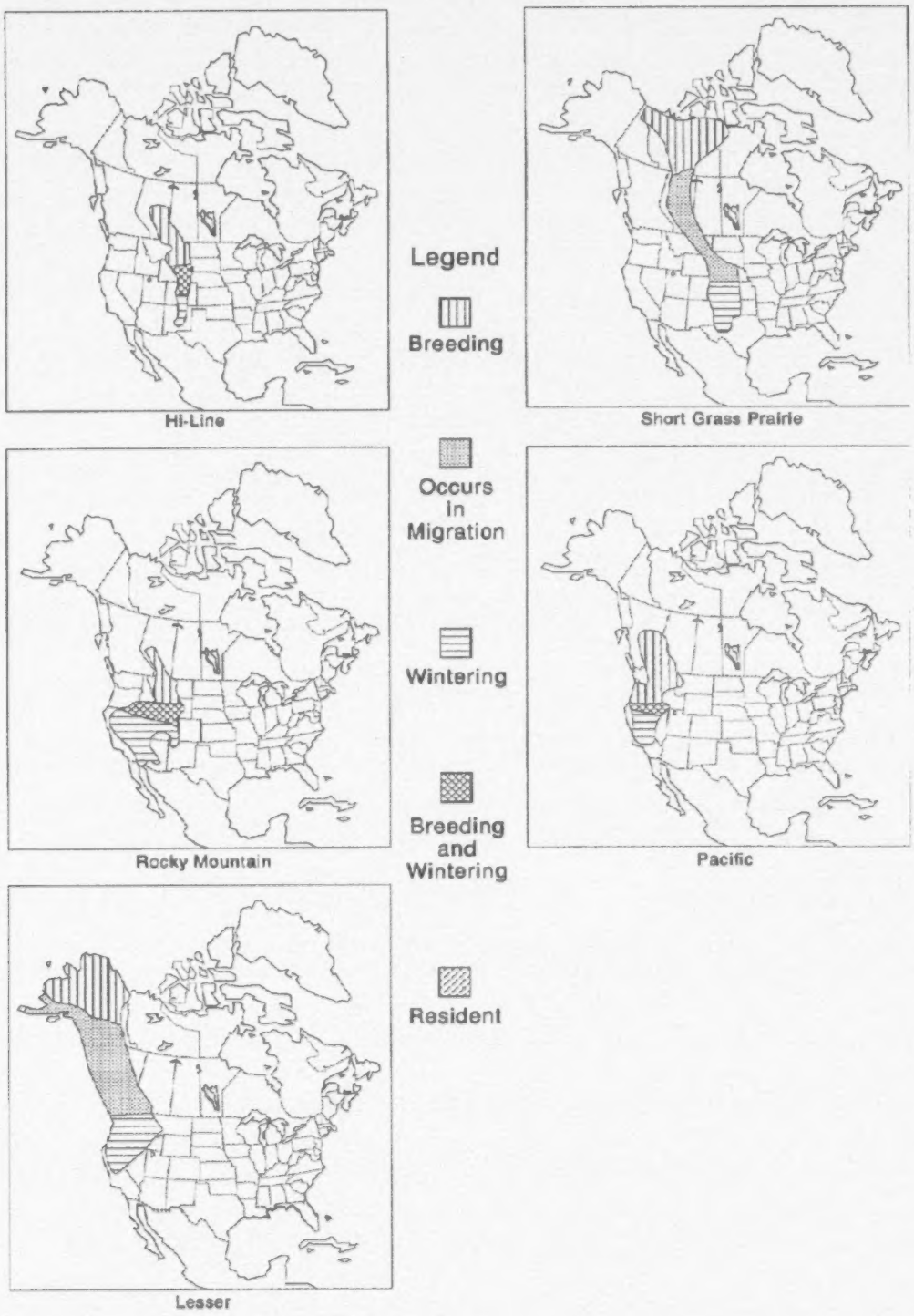


Figure 31c. Canada Goose Populations in North America: HLP, RMP, PP and LP. Mixed Cackling / Canada Goose Population: SGPP

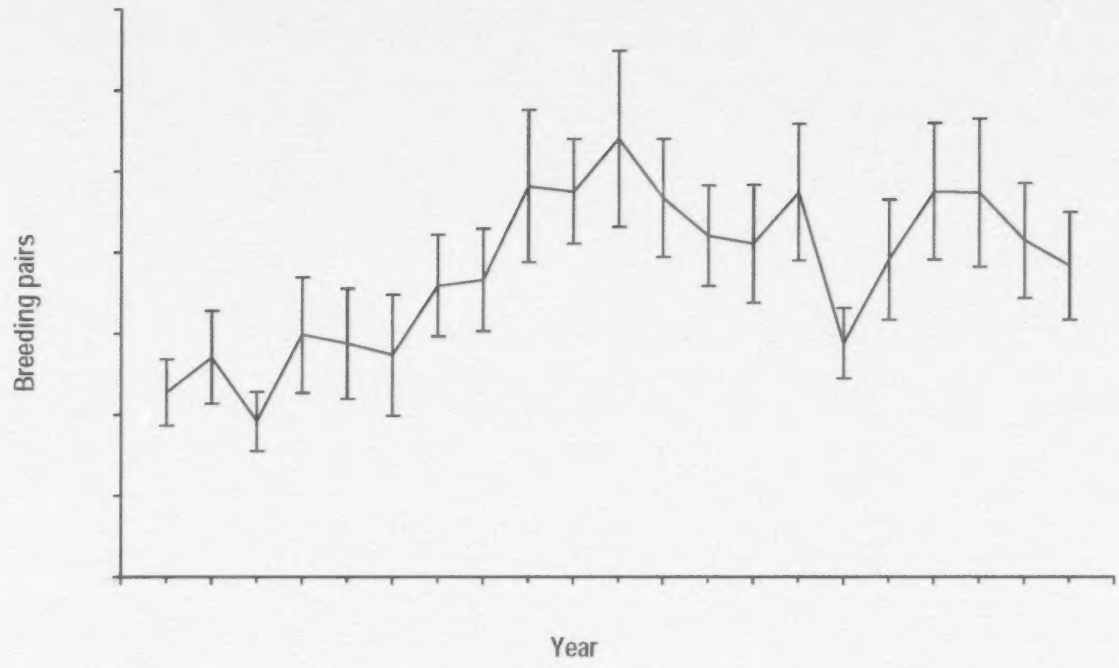


Figure 32. Breeding Pairs of the North Atlantic Population Canada Geese in Stratum 2 of the Eastern Waterfowl Survey Area (see Figure 1)

Breeding pairs (±1 ET).

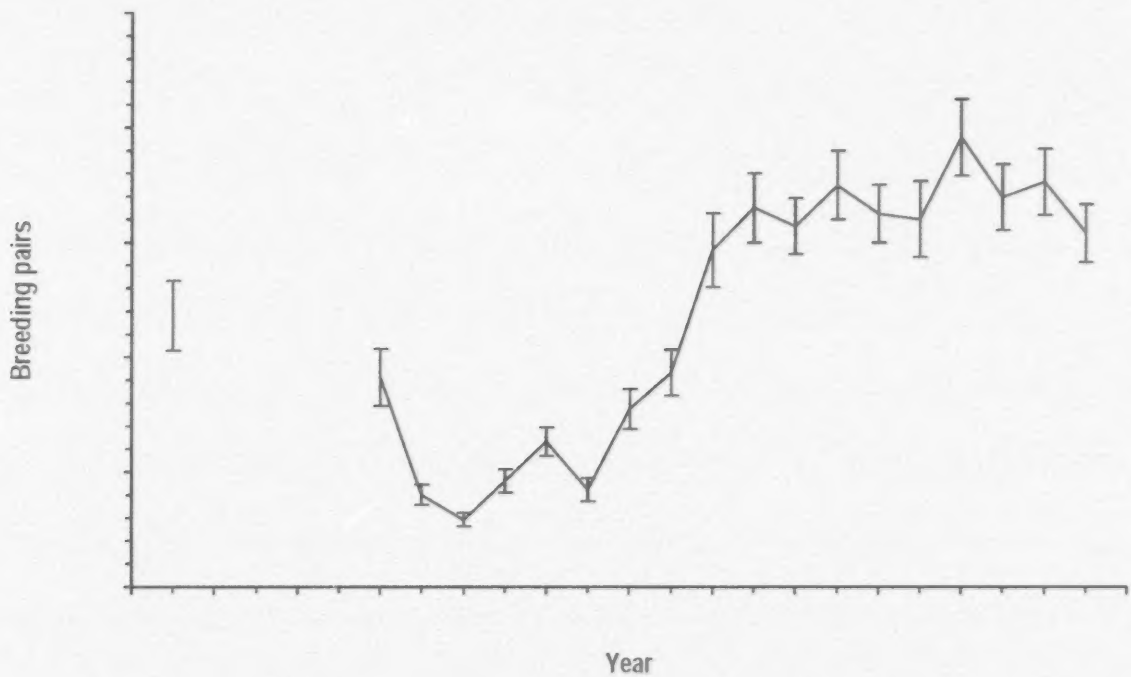


Figure 33. Breeding Pairs of the Atlantic Population Canada Geese in the Ungava Peninsula of northern Quebec

Breeding pairs ± 1SE. No surveys were conducted from 1989-1992. (Source: Harvey and Rodrigue, 2010)

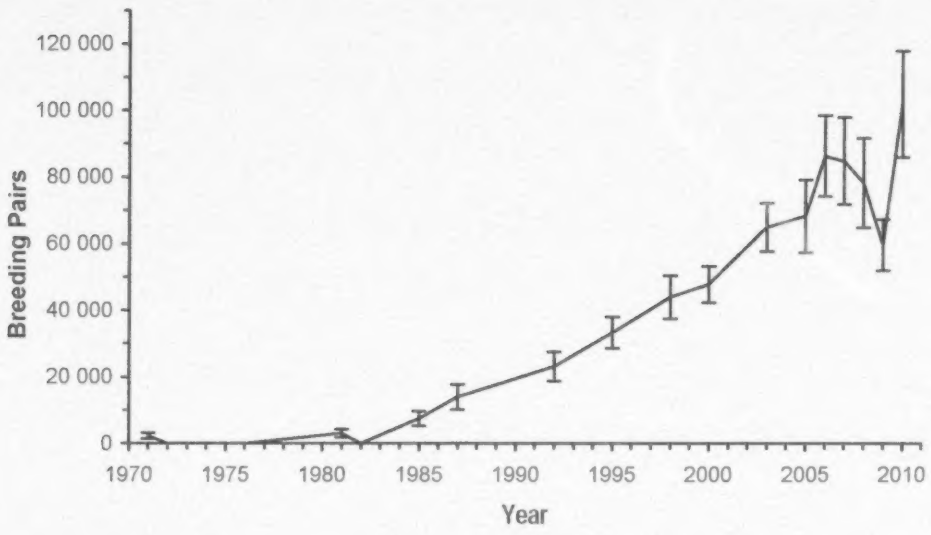


Figure 34. Estimated Breeding Pairs of Temperate-breeding Canada Geese (± 1 SE) in Southern Ontario Population, 1971-2010
(Source: S. Meyer, CWS, Ontario Region)

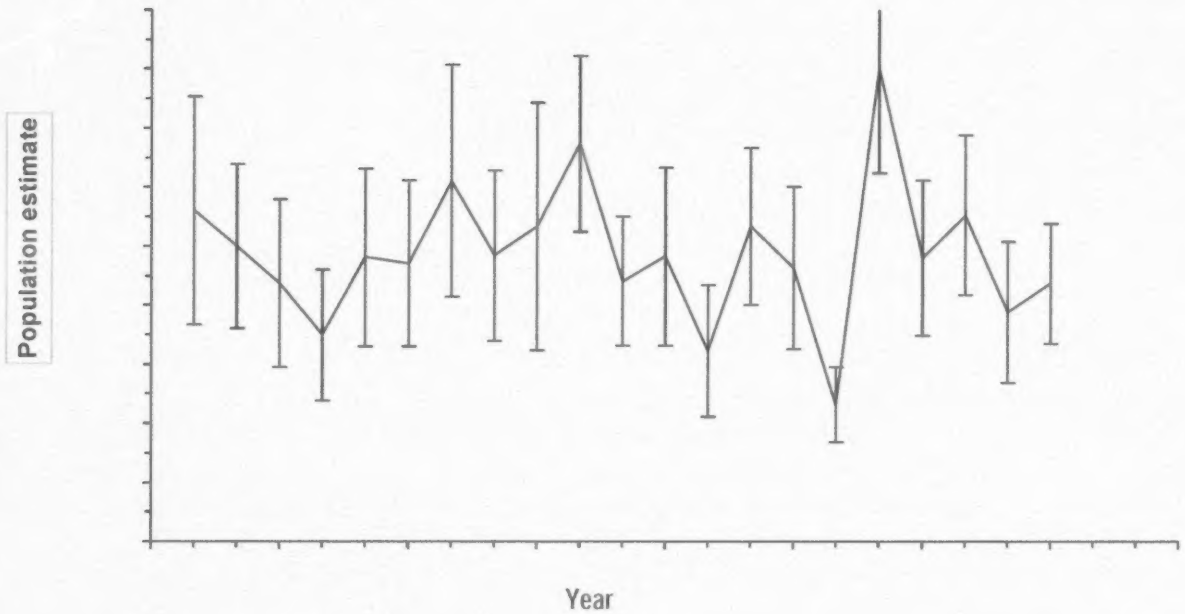


Figure 35. Southern James Bay Population Canada Geese Spring estimates
(2002-2010 data, ± 95% CI; [Source: Brook and Hughes, 2010a])

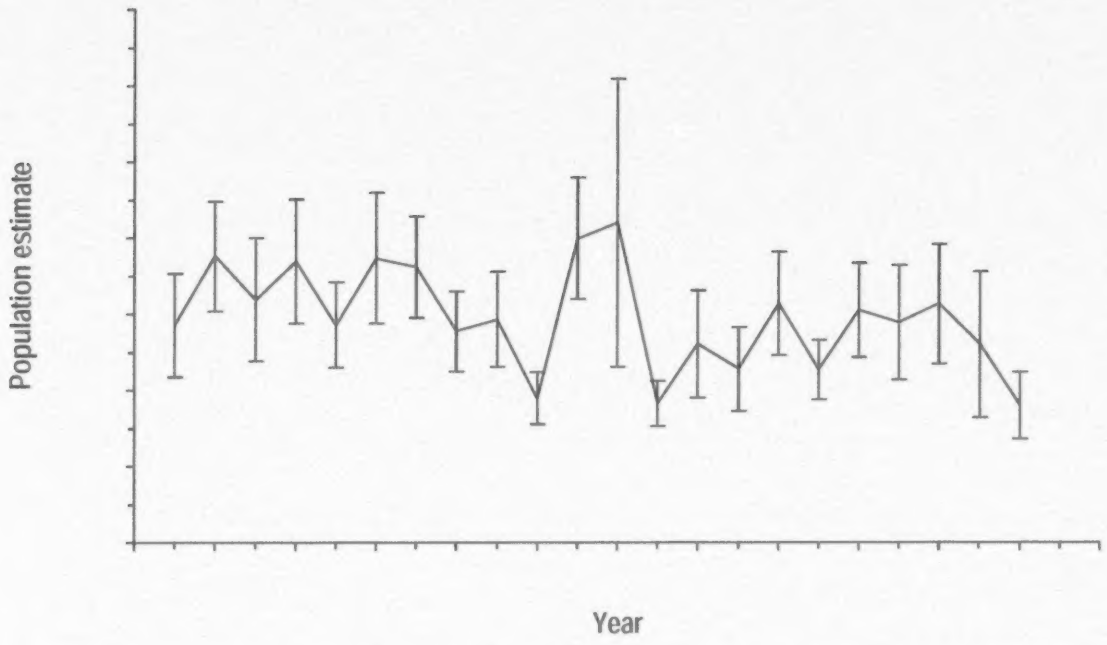


Figure 36. Mississippi Valley Population Canada Geese Spring Estimates (± 95% CI)
(Source: Brook and Hughes 2010b)

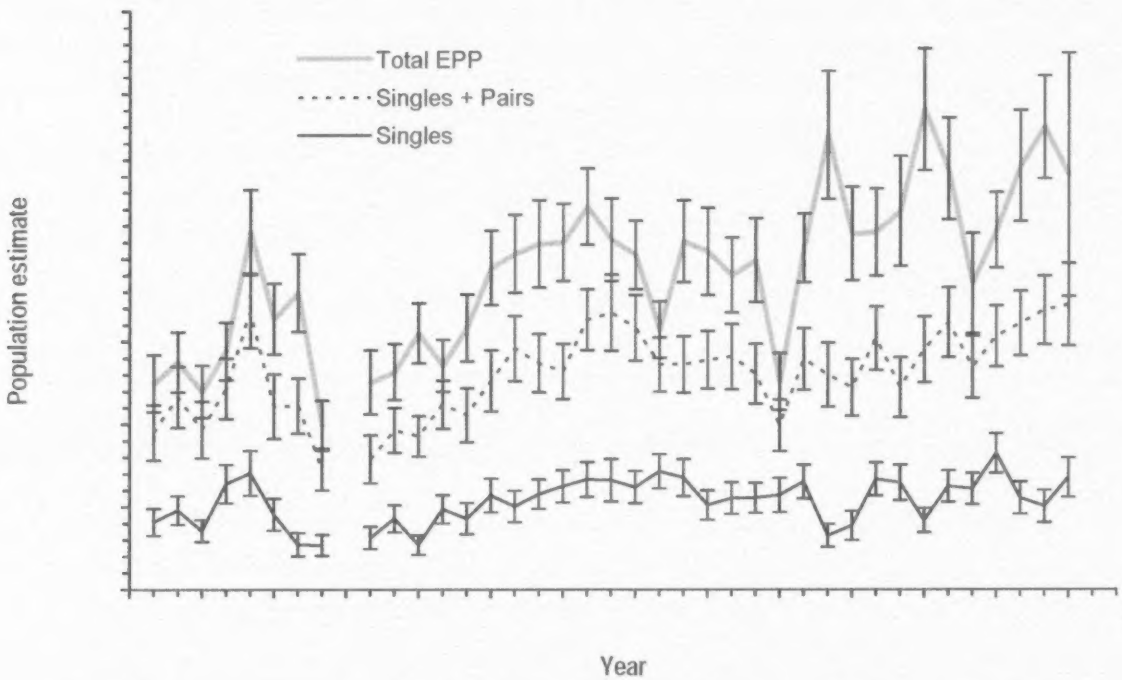


Figure 37. Eastern Prairie Population Canada Geese Spring Estimates (± 95% CI)
(Source: D. Fronczak 2010). No survey was conducted in 1980.

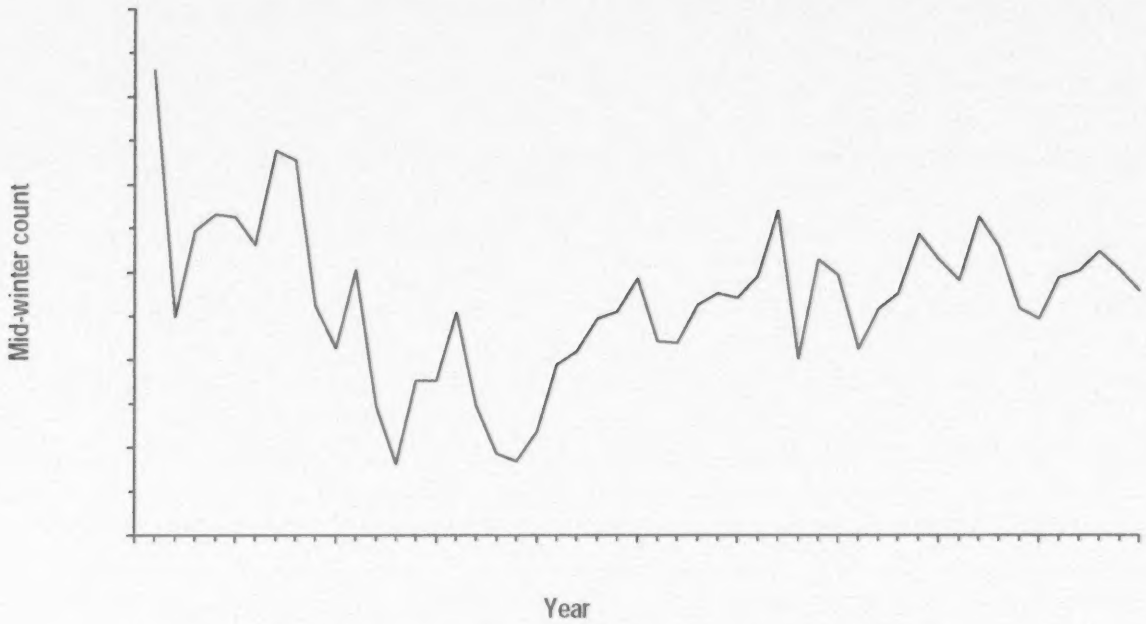


Figure 38. Mid-winter inventory of Atlantic Brant in the Atlantic Flyway
(Source: Klimstra and Padding, 2010)

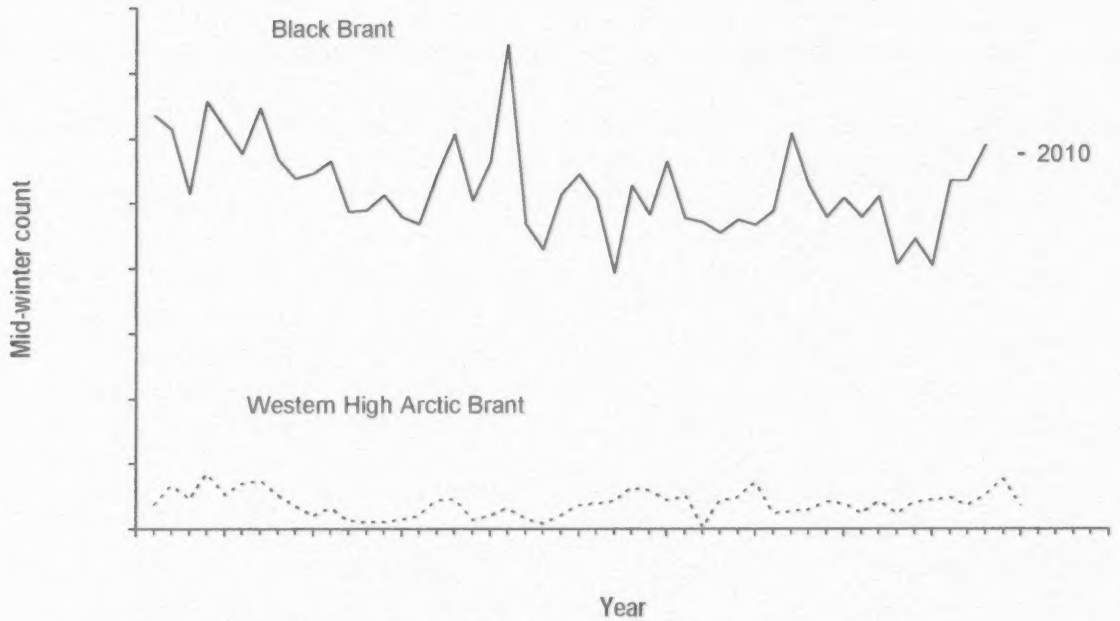


Figure 39. Mid-winter inventory of Black and Western High Arctic Brant
Note that beginning in 1986 Black Brant numbers include counts along the Alaska coast. No survey in 2009.
(Source: Collins and Trost 2010).

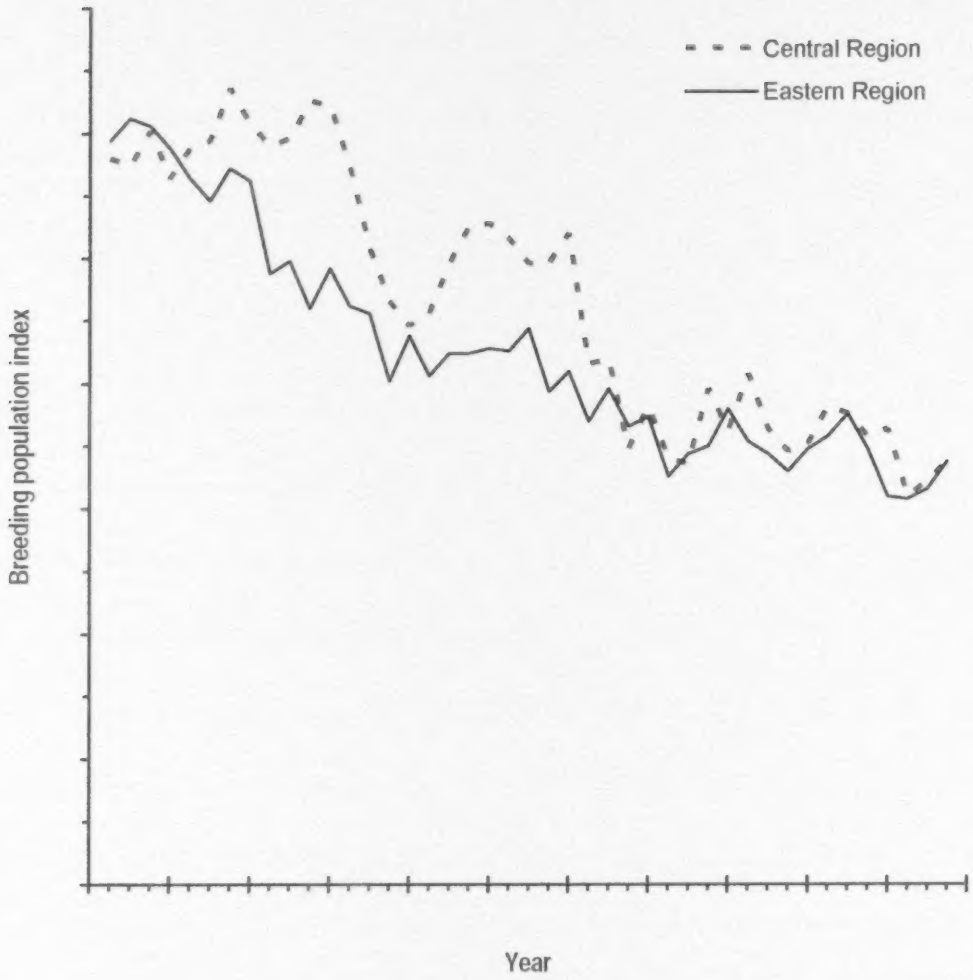


Figure 40. American Woodcock Breeding Population Indices
Indices (singing males per route) from the Singing-ground Survey (Source: Cooper and Parker 2010)

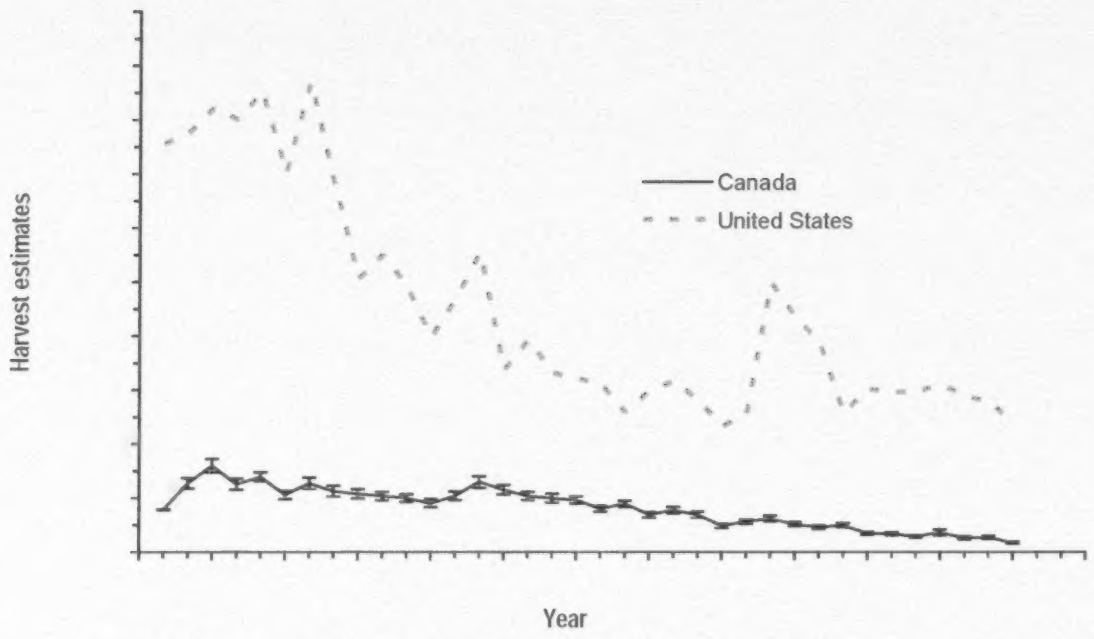


Figure 41. American Woodcock Harvest in Canada and the United States

(Source: Gendron and Collins 2010, CWS; Cooper and Parker 2010). The USFWS implemented an improved national harvest survey. The results from 1999 onward are considered preliminary and are not directly comparable to those prior to 1999.

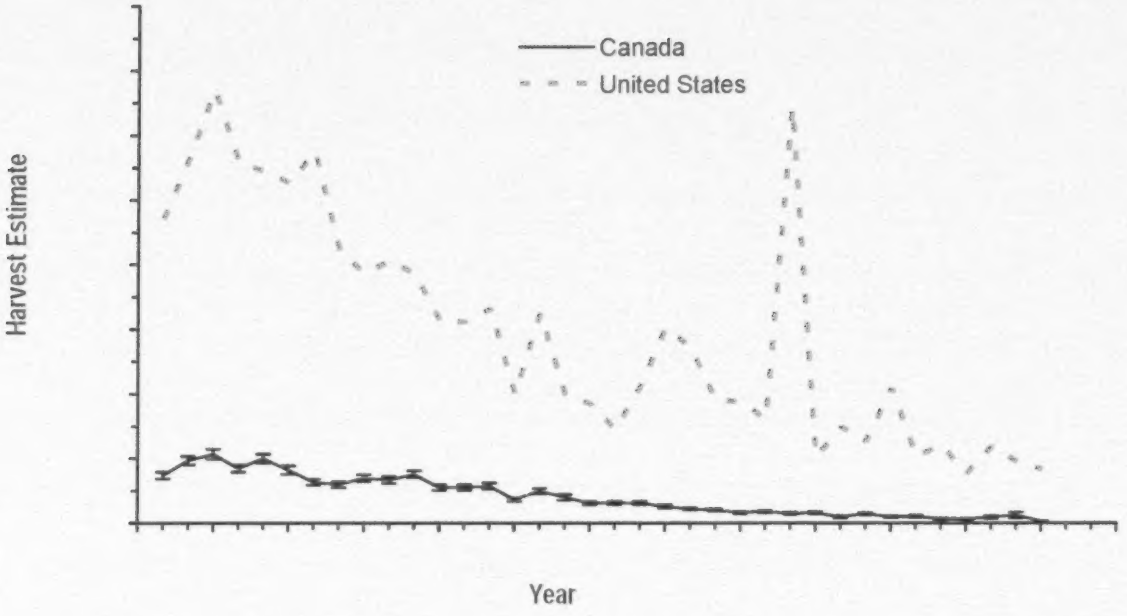


Figure 42. Wilson's Snipe Harvest Estimates in Canada and the United States
(Source: M. Gendron & B. Collins, CWS; and Raftovich, R.V. et al., 2010). The USFWS implemented an improved national harvest survey. The results from 1999 onward are considered preliminary and are not directly comparable to those prior to 1999.

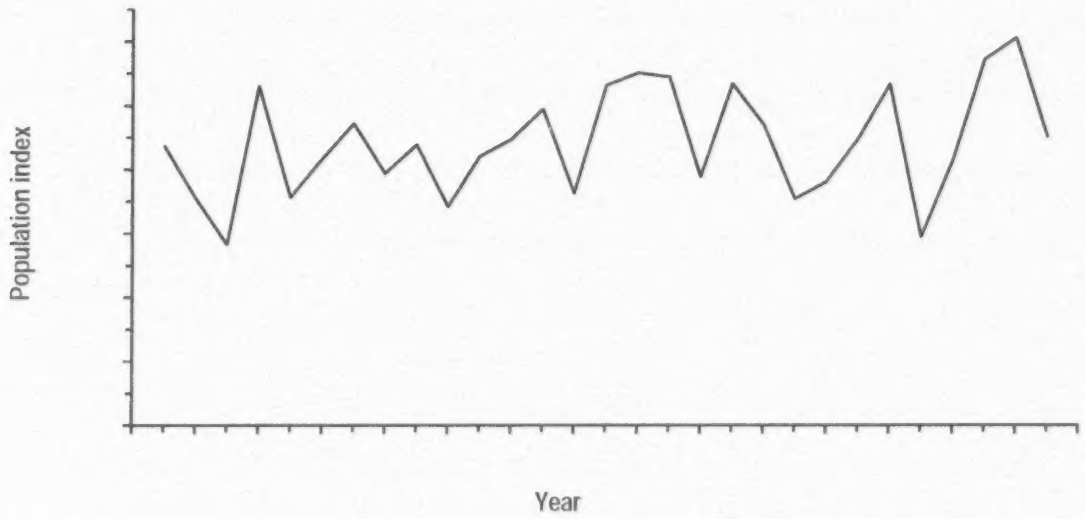


Figure 43. Mid-continent Population Sandhill Crane Spring Indices
Note: the 2010 value is for the Central Platte River Valley only, and is uncorrected for visibility bias (Kruse et al., 2010).

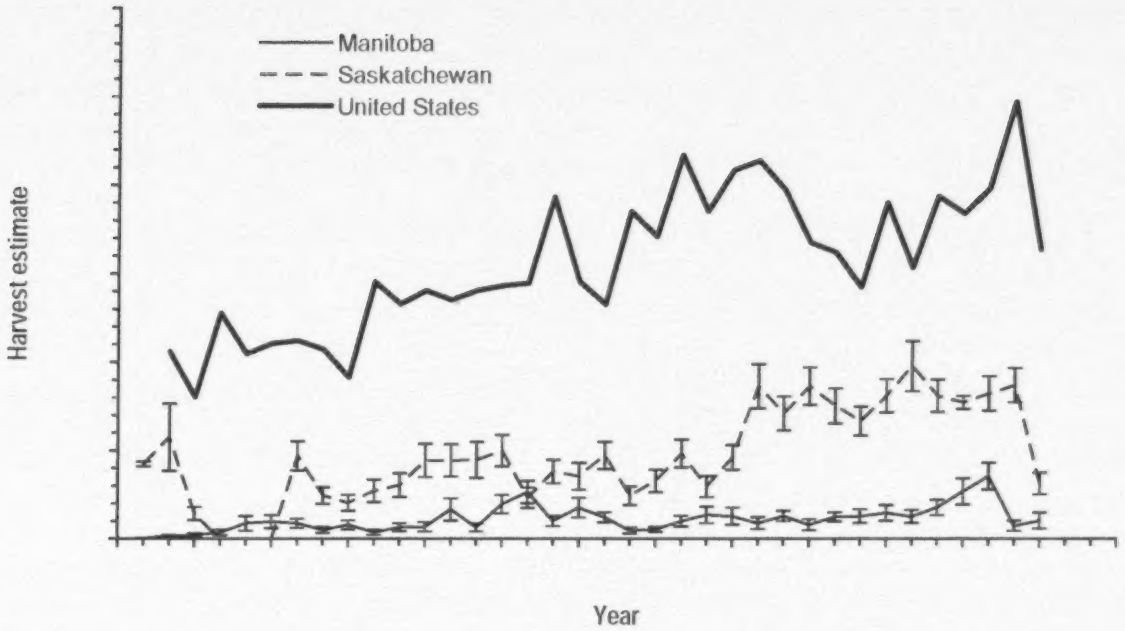


Figure 44. Harvest Estimates of Sandhill Cranes in Canada and the United States
Canadian harvest estimates ±1 SE (M. Gendron & B. Collins, CWS), and U.S. harvest estimates (K. L. Kruse et al., 2010).The USFWS implemented an improved national harvest survey. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

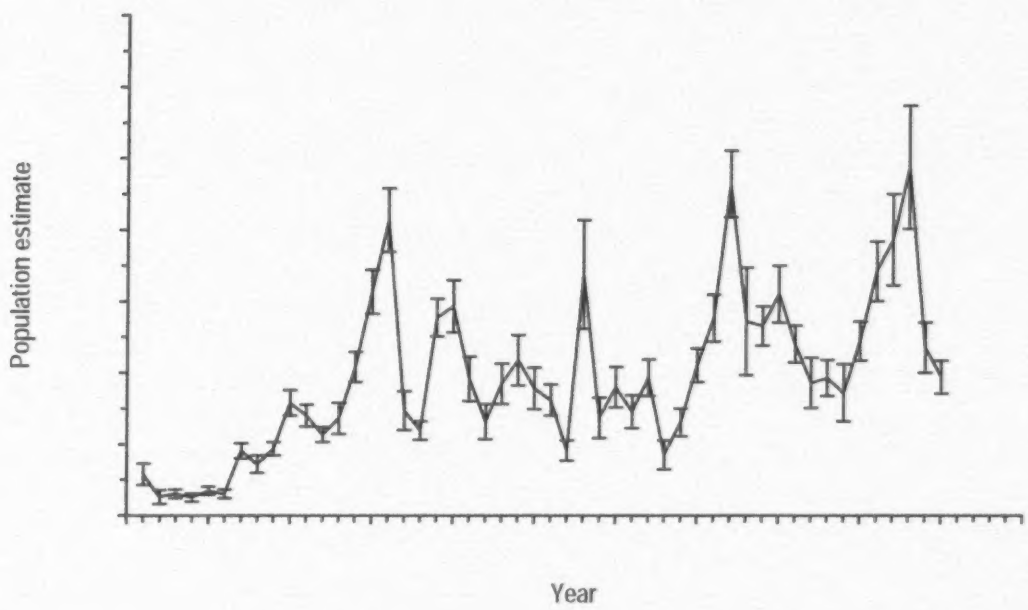


Figure 45. American Coot Breeding Population in the Canadian Prairies (± 1 SE) from the Waterfowl Breeding Population and Habitat Survey

Table 1. Trends in indicated breeding pairs of inland duck species in southern Ontario from 1971 to 2010. Data from breeding waterfowl surveys of ground and helicopter plots.

	Long-term	Recent
Species	1971 - 2010	2000 - 2010
American Black Duck	-0.001	0.088
Mallard	0.013	0.010
Wood Duck	0.044	0.087
Green-winged Teal	0.016	-0.052
Blue-winged Teal	-0.068	-0.020
Ring-necked Duck	0.049	0.023
Hooded Merganser	0.032	0.102
Common Merganser	0.061	–

Data source: Shawn Meyer (CWS, Ontario Region).

Note: Trends are expressed as an annual percentage change. Methods to test statistical significance of these trends have not yet been developed. No indication of significance can be given

Table 2. Harvest estimates of American Black Ducks in Canada and the United States

	Canada													United States[1]				Continental
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT/NU	YT	Total	AF	MF	CF	Total	Total
1974	19 543	11 684	29 594	14 008	75 534	61 702	511						212 576	294 700	93 300	999	388 999	601 575
1975	35 354	14 620	59 467	21 876	90 593	85 070	262	118					307 360	275 000	81 000	1 197	357 197	664 557
1976	23 770	21 891	48 624	23 342	120 622	96 761	180	586	143	64			335 983	327 500	97 800	837	426 137	762 120
1977	38 835	18 044	46 186	20 568	129 618	82 886	727	547		48			337 459	194 900	78 900	249	274 049	611 508
1978	49 008	19 660	47 874	34 598	130 379	89 818	379			66			371 782	262 200	74 600		336 800	708 582
1979	44 658	12 732	33 687	24 339	112 926	87 557	242	363	256	266			317 026	231 000	68 300		299 300	616 326
1980	32 316	21 568	67 341	28 094	120 602	91 503	2 171	268					363 863	309 200	87 100	751	397 051	760 914
1981	38 047	16 133	58 692	26 460	105 733	76 298	337	213		41			321 954	230 900	59 000	505	290 405	612 359
1982	26 961	25 771	47 447	32 130	117 514	86 650	161	426					337 060	186 700	48 400		235 100	572 160
1983	32 956	25 049	57 725	31 007	101 637	60 454	259						309 087	139 100	58 800	317	198 217	507 304
1984	26 119	23 256	51 880	33 283	106 868	64 272	327		518				306 523	147 800	53 900		201 700	508 223
1985	28 556	18 535	44 397	32 261	110 998	64 692	427	135					300 001	148 100	41 700	180	189 980	489 981
1986	27 278	18 650	46 612	27 896	114 493	60 461	367	260	151				296 168	140 700	37 400	442	178 542	474 710
1987	20 134	18 114	39 138	27 218	129 612	61 176							295 442	135 400	36 700	112	172 212	467 654
1988	20 137	20 364	44 311	30 193	127 134	58 840		151	92				301 222	124 600	29 000	512	154 112	455 334
1989	29 299	11 548	47 322	25 582	99 675	47 518	144						261 088	148 800	44 600	326	193 726	454 814
1990	22 662	11 369	38 012	26 743	105 277	38 357	106	621	286	103			243 537	110 600	32 300	422	143 322	386 859
1991	15 073	14 499	39 295	20 122	85 220	48 670	1 189	312	1 329	229			225 938	126 400	40 900	220	167 520	393 458
1992	13 487	8 043	41 079	23 090	82 134	38 228	138	239	73				206 511	97 700	37 900	106	135 706	342 217
1993	13 133	10 741	36 298	19 591	87 869	34 556	1 125						203 313	105 400	41 200	66	146 666	349 979
1994	16 507	10 221	32 670	23 389	67 440	24 774	254	169				35	175 459	101 600	28 600	266	130 466	305 925
1995	15 461	13 355	40 546	29 332	54 776	33 470		204		17			187 161	126 500	42 300		168 800	355 961
1996	19 447	9 469	39 759	20 418	49 219	25 289							163 601	84 000	34 500		118 500	282 101
1997	18 816	12 982	32 666	17 966	56 103	26 309	265	147	215				165 469	110 200	41 500	79	151 779	317 248
1998	22 410	6 789	33 852	22 802	49 065	23 091	165		81	124			158 379	119 600	56 100	236	175 936	334 315
1999[2]	19 058	10 782	44 658	22 445	51 385	26 579	36						174 943	111 400	42 200		153 600	328 543
2000	21 605	6 980	43 922	18 083	43 476	19 995	204	653					154 918	127 500	52 000		179 500	334 418
2001	16 800	9 465	26 729	12 879	38 717	19 185	293						124 068	94 559	30 636		125 195	249 263
2002	18 021	6 214	28 310	14 449	36 346	19 130		76	89			r	122 635	128 620	47 465	453	176 538	299 173
2003	10 174	7 228	26 010	15 219	35 077	15 176		334				r	109 218	95 108	33 971	134	129 213	238 431
2004	12 888	4 827	16 969	9 775	30 588	16 710						r	91 757	76 263	35 692		111 955	203 712
2005	9 333	4 560	16 717	9 031	34 472	15 276	191						89 580	93 406	36 365	115	129 886	219 466
2006	16 529	5 168	20 630	11 159	33 900	16 644							104 030	93 356	35 840		129 196	233 226
2007	20 485	7 054	24 180	10 391	27 596	13 462	140	503				r	103 811	98 705	38 692		137 397	241 208
2008	22 067	5 829	22 764	12 285	29 154	11 094	160	184				r	103 537	90 196	29 641	312	120 150	223 687
2009[3]	13 583	5 049	18 788	9 719	29 150	14 173	155						90 617	81 287	30 373	220	111 880	202 497

[1]AF: Atlantic Flyway, MF: Mississippi Flyway, CF: Central Flyway.

[2]The USFWS implemented an improved national harvest survey in 1999. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

[3]Harvest data for the U.S. are preliminary.

Data source: M. H. Gendron and B. Collins (CWS), and R.V. Raftovich *et al.* 2010 (USFWS).

Table 3. **Estimates of trends in numbers of May ponds and Duck breeding populations in the traditional survey area of the Waterfowl Breeding Population and Habitat Survey.**

Species	Time period	Region									
		Alaska		Western Boreal Canada		Canadian Prairies		U.S. Prairies		Entire survey area	
		(11 strata)		(17 strata)		(15 strata)		(9 strata)		(52 strata)	
May ponds[1]	1974-2010	N/A		N/A		-0.1	(15)	1.6 *	(9)	N/A	
	2001-2010	N/A		N/A		6.6 *	(15)	6.1 *	(9)	N/A	
	2006-2010	N/A		N/A		-6.8 *	(15)	16.6 *	(9)	N/A	
Total ducks[2]	1961-2010	1.6 *	(11)	-0.3	(17)	-0.2	(15)	1.7 *	(9)	0.4	(52)
	2001-2010	-1.6	(11)	1.0	(17)	3.7 n	(15)	4.9 *	(9)	2.4 *	(52)
	2006-2010	-1.0	(11)	9.1 *	(17)	-10.8 *	(15)	19.1 *	(9)	2.9	(52)
Mallard	1961-2010	3.1 *	(11)	-0.3	(17)	-0.5	(15)	2.1 *	(9)	0.3	(52)
	2001-2010	-4.4 *	(11)	1.1	(17)	1.1	(15)	2.5 *	(9)	1.1	(52)
	2006-2010	1.0	(11)	14.6 *	(17)	-5.0 *	(15)	6.5 n	(9)	3.2	(52)
Gadwall	1961-2010	7.0	(9)	2.7	(17)	1.4 *	(15)	3.5 *	(9)	2.3 *	(50)
	2001-2010	1.0	(9)	-7.2 *	(17)	5.3 *	(15)	1.4 *	(9)	2.8 *	(50)
	2006-2010	N/A	(9)	-19.0 *	(17)	-6.7 *	(15)	11.6 *	(9)	0.1	(50)
American Wigeon	1961-2010	4.4 *	(11)	-0.8 *	(17)	-2.3 *	(15)	1.5	(9)	-0.2	(52)
	2001-2010	-1.6 *	(11)	-0.5	(17)	3.2	(15)	8.1 *	(9)	0.6	(52)
	2006-2010	0.7	(11)	1.3	(17)	-10.2 *	(15)	21.0	(9)	1.1	(52)
Green-winged Teal	1961-2010	4.8 *	(11)	1.1 *	(17)	0.7	(15)	2.5 *	(9)	1.5 *	(52)
	2001-2010	-1.6	(11)	4.8	(17)	11.1 *	(15)	6.1 *	(9)	4.2 *	(52)
	2006-2010	1.6	(11)	11.9 n	(17)	-1.5	(15)	44.6 *	(9)	8.0 *	(52)
Blue-winged Teal	1961-2010	6.3	(8)	-0.4	(16)	0.6	(15)	1.7 *	(9)	1.0 *	(48)
	2001-2010	30.9	(8)	-2.0	(16)	4.9 n	(15)	5.3 *	(9)	4.6 *	(48)
	2006-2010	N/A		-3.9	(16)	-14.3 *	(15)	21.8 *	(9)	2.9	(48)
Northern Shoveler	1961-2010	7.9 *	(11)	0.9	(17)	1.4 *	(15)	1.9 *	(9)	1.9 *	(52)
	2001-2010	-3.0	(11)	1.1	(17)	5.7 *	(15)	8.7 *	(9)	4.7 *	(52)
	2006-2010	5.8	(11)	7.3	(17)	-16.3 *	(15)	36.7 *	(9)	1.6	(52)
Northern Pintail	1961-2010	0.6 n	(11)	-1.7 *	(17)	-2.8 *	(15)	-1.2 *	(9)	-1.5 *	(52)
	2001-2010	0.4	(11)	6.9 *	(17)	1.2	(15)	11.2 *	(9)	3.9 *	(52)
	2006-2010	0.3	(11)	19.4 *	(17)	-24.2 *	(15)	31.2 *	(9)	0.4	(52)
Redhead	1961-2010	1.5	(10)	0.1	(17)	1.2 *	(15)	1.2 n	(9)	1.0 *	(51)
	2001-2010	85.5	(10)	1.4	(17)	7.7 *	(15)	8.3 n	(9)	7.8 *	(51)
	2006-2010	-34.7	(10)	-12.0	(17)	-8.6 *	(15)	36.2 *	(9)	3.4	(51)
Canvasback	1961-2010	1.0 n	(11)	0.5	(17)	0.2	(15)	1.8 n	(9)	0.5 n	(52)
	2001-2010	-9.2 *	(11)	-1.7	(17)	4.5	(15)	9.3 n	(9)	1.8	(52)
	2006-2010	-11.6	(11)	-8.4	(17)	-12.9 *	(15)	35.7 *	(9)	-5.8	(52)
Scaup spp.	1961-2010	0.2	(11)	-1.6 *	(17)	-1.0 n	(15)	2.4	(9)	-1.0 *	(52)
	2001-2010	-0.4	(11)	1.7 *	(17)	2.1	(15)	1.4	(9)	1.3 *	
	2006-2010	-4.1 n	(11)	16.8 *	(17)	-7.3 *	(15)	17.8 *	(9)	7.5 *	(52)
Ring-necked Duck	1961-2010	49.5 *	(11)	2.4 *	(17)	2.4 *	(15)	8.6	(9)	2.6 *	(52)
	2001-2010	-8.4 *	(11)	-0.2	(17)	1.2	(15)	6.0	(9)	-0.4	(52)
	2006-2010	-17.9 n	(11)	7.6	(17)	-5.0	(15)	31.6 n	(9)	5.6	(52)
Ruddy Duck	1961-2010	N/A		2.6 *	(16)	1.0	(15)	3.9 *	(9)	1.9 *	(44)
	2001-2010	N/A		-4.6	(16)	-4.4	(15)	2.4	(9)	-1.7	(44)
	2006-2010	N/A		16.3	(16)	-18.3 *	(15)	11.9 *	(9)	-3.2	(44)

Trends were calculated using the estimating equations technique (Link and Sauer 1994) and are expressed as an annual percentage change.

The number of strata is given in parentheses (a minimum of 5 strata was deemed necessary to perform a trend analysis).

* Trend significant at $p < 0.05$

[1]Adjusted May pond estimates for the U.S. Prairies are only available since 1974; pond estimates from strata 75 and 76 (Western Boreal Canada) which are counted since 1989 were excluded from the analysis.

[2]Total ducks include all species of ducks observed during the survey, including sea ducks.

Table 3 cont'd. Estimates of trends in numbers of May ponds and Duck breeding populations in the traditional survey area of the Waterfowl Breeding Population and Habitat Survey.

Species	Time Period	Region				
		Alaska (11 strata)	Western Boreal Canada (17 strata)	Canadian Prairies (15 strata)	U.S. Prairies (9 strata)	Entire Survey Area (52 strata)
Mergansers	1961-2010	8.2 * (11)	2.0 * (17)	6.3 * (15)	6.0 (9)	2.1 * (52)
	2001-2010	2.2 (11)	-4.2 n (17)	9.0 * (15)	-13.1 (9)	-3.6 (52)
	2006-2010	-0.9 (11)	4.6 (17)	22.3 (15)	49.9 (9)	5.3 (52)
Goldeneyes	1961-2010	-0.4 (11)	1.4 (17)	3.2 * (15)	0.2 (8)	1.3 * (51)
	2001-2010	-9.3 * (11)	-0.5 (17)	7.4 * (15)	N/A	-0.4 (51)
	2006-2010	-16.3 * (11)	-5.6 (17)	-4.7 (15)	N/A	-6.1 (51)
Bufflehead	1961-2010	0.3 n (11)	1.9 * (17)	3.1 * (15)	6.1 * (9)	1.9 * (52)
	2001-2010	2.9 (11)	2.8 n (17)	4.6 (15)	2.0 (9)	3.1 * (52)
	2006-2010	2.0 (11)	5.5 (17)	-1.3 (15)	22.3 (9)	3.9 (52)
Long-tailed Duck	1961-2010	-1.5 * (11)	-3.8 * (15)	1.4 (7)	N/A	-2.9 * (34)
	2001-2010	-0.4 (11)	-3.3 (15)	N/A	N/A	-1.7 (34)
	2006-2010	-10.6 (11)	12.7 (15)	N/A	N/A	-1.2 (34)
Scoter spp.	1961-2010	-0.4 (11)	-1.3 * (17)	-11.2 * (12)	N/A	-1.1 * (44)
	2001-2010	1.3 (11)	2.6 * (17)	-19.1 (12)	N/A	2.4 * (44)
	2006-2010	-11.3 * (11)	16.9 * (17)	33.2 (12)	N/A	8.3 (44)

* Trend significant at $p < 0.05$.

Table 4. Harvest estimates of Mallards in Canada and the United States

	Canada													United States[1] (including Alaska)					Continental
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT NU	YT	Total	AF	MF	CF	PF	Total	Total
1974	154	120	406	761	50 006	191 532	105 723	266 291	488 440	62 596			1266 076	283 600	2 245 000	309 469	1 166 691	4 604 760	5 870 836
1975	774	405	972	583	57 791	296 173	159 142	567 985	521 935	122 725	1 698	797	1730 980	409 200	2 518 100	934 916	1 158 971	5 021 187	6 752 167
1976	770	256	752	748	71 851	322 047	204 598	606 229	609 576	114 198	3 229	898	1935 163	478 400	2 409 400	975 705	1 226 374	5 089 879	7 025 042
1977	836	196	1 155	992	81 836	268 878	165 257	391 986	510 286	121 066	3 073	584	1556 254	388 400	2 270 200	789 526	987 899	4 436 025	5 992 279
1978	850	259	2 659	452	61 567	322 006	239 298	395 276	392 319	115 038	2 098	1 290	1523 052	442 500	2 257 600	1 059 783	1 265 553	5 024 936	6 547 988
1979	555	465	3 077	725	70 597	266 018	245 016	419 509	485 014	117 176	1 182	1 673	1611 007	437 600	2 246 100	923 077	1 065 704	4 772 481	6 383 488
1980		948	3 066	1 436	82 027	290 941	210 152	255 042	480 188	104 768	2 551	2 473	1532 592	435 100	2 347 500	796 838	1 081 558	4 660 996	6 194 588
1981	2 945	1 461	2 526	2 491	91 946	279 641	175 213	221 119	392 273	114 672	1 700	1 003	1296 930	444 600	2 062 000	734 424	1 051 566	4 342 590	5 639 520
1982	428	410	1 405	1 792	90 289	335 813	148 862	241 734	296 124	92 492	1 552		1213 911	295 900	1 781 600	683 066	1 047 074	3 907 640	5 121 551
1983	1 067	937	4 044	2 557	87 349	297 944	160 521	284 403	364 000	121 758	2 417	603	1327 600	417 400	2 017 900	772 567	1 231 524	4 419 401	5 747 001
1984	1 097	738	2 120	1 668	67 432	284 128	117 207	183 300	306 224	89 453	4 501	1 266	1059 244	382 700	1 796 100	742 790	1 002 926	3 924 516	4 983 760
1985	794	1 149	3 310	3 258	97 027	290 333	87 172	158 302	180 117	81 943	4 153	914	911 402	319 900	1 532 900	510 761	957 871	3 321 432	4 232 914
1986	2 933	755	3 135	2 526	94 303	265 491	112 360	151 384	182 749	72 263	811	433	879 145	362 700	1 550 100	586 619	870 893	3 370 312	4 249 457
1987	1 020	728	3 692	3 141	116 462	315 101	126 678	154 961	211 929	75 591	1 120	192	1020 605	340 200	1 458 800	612 465	792 950	3 204 515	4 225 120
1988		902	2 304	1 620	83 748	230 556	64 324	75 852	129 595	63 700	2 543	412	668 527	257 200	874 500	324 709	532 958	1 989 367	2 657 894
1989	1 280	925	4 339	2 246	79 419	260 152	70 122	75 645	188 516	57 269	438	772	744 134	321 400	1 094 500	335 216	592 179	2 333 296	3 077 420
1990	1 162	1 028	3 567	3 183	95 524	261 267	60 051	79 494	175 921	60 395	966	290	734 538	267 000	1 091 000	326 984	602 541	2 287 525	3 022 063
1991	949	1 106	3 712	4 582	84 482	229 026	60 902	70 050	122 105	51 458	94	641	629 138	317 600	1 139 600	293 744	553 618	2 354 562	2 983 700
1992	863	199	6 407	5 243	87 824	196 647	65 991	68 765	94 795	52 172	605	298	579 809	294 100	1 250 400	366 488	627 229	2 538 227	3 118 036
1993	1 025	1 178	5 029	3 755	100 002	202 647	42 969	50 351	93 094	45 181	1 178	560	506 999	212 500	1 338 200	398 079	687 979	2 736 658	3 273 657
1994	795	864	3 305	2 894	107 222	197 633	57 923	88 948	113 063	50 412	2 042	265	625 411	226 500	1 524 700	510 957	744 432	3 106 589	3 734 000
1995	532	751	4 622	5 131	93 307	176 680	74 206	104 296	111 048	40 792	1 509	278	600 342	424 100	2 347 100	684 402	940 265	4 405 867	5 006 209
1996	351	1 024	4 286	4 044	82 201	176 869	91 265	121 608	115 668	42 447	1 326		641 089	408 000	2 490 900	764 215	1 185 491	4 851 606	5 492 695
1997	1 461	417	8 047	5 371	77 584	178 168	107 379	133 017	151 167	55 513	427	126	718 698	478 900	2 852 000	896 166	1 161 510	5 378 576	6 097 274
1998	1 623	1 011	5 440	7 512	76 320	164 431	104 469	129 461	119 826	52 663	881	276	663 913	445 500	2 762 800	953 367	1 428 079	5 589 746	6 253 664
1999[2]	1 188	667	6 205	4 866	69 568	121 801	92 637	102 714	105 126	48 002		220	603 194	438 000	3 060 800	878 424	1 121 810	5 499 044	6 102 238
2000	1 511	1 915	5 481	5 999	81 655	162 352	78 201	195 276	107 203	49 272	510	72	689 447	499 100	3 041 100	1 112 643	1 025 082	5 677 925	6 367 272
2001	600	1 192	5 720	7 046	79 895	166 628	92 114	107 411	94 698	35 574	642	229	591 749	467 064	2 768 031	1 151 367	897 216	5 283 678	5 875 427
2002	299	2 175	6 498	6 001	66 522	147 844	77 991	118 856	80 706	37 370	1 701	609	546 592	554 700	2 423 124	1 000 381	934 379	4 915 597	5 462 179
2003	694	803	4 711	6 509	58 871	139 096	66 402	126 296	73 086	35 382	409	109	511 469	427 391	2 571 461	942 199	1 078 226	5 019 204	5 530 673
2004	1 985	1 100	5 245	5 227	65 284	132 186	75 968	129 627	78 269	28 515	275	36	523 717	429 216	2 199 801	968 774	929 274	4 527 295	5 051 012
2005	754	1 681	4 544	4 732	72 231	115 284	87 315	144 293	78 798	33 586	688		544 006	444 205	2 049 242	967 238	1 075 713	4 426 629	4 980 645
2006	753	1 122	5 460	6 289	72 245	124 751	111 025	174 174	88 533	28 928	215		613 629	399 651	2 286 643	709 241	1 272 876	4 668 411	5 282 037
2007	1 837	1 289	5 711	7 020	65 187	119 403	68 121	163 912	82 133	30 167	897	265	545 952	429 917	2 514 119	812 291	1 102 056	4 858 382	5 404 334
2008	48	1 725	4 748	5 662	69 899	119 971	60 680	150 906	97 567	35 924		488	547 626	500 480	2 292 128	666 271	1 103 089	4 554 968	5 102 594
2009[2]	80	651	4 079	3 377	55 216	106 537	61 460	135 546	62 778	32 726		67	472 527	413 643	2 076 235	734 079	906 340	4 130 197	4 607 724

[1]AF: Atlantic Flyway, MF: Mississippi Flyway, CF: Central Flyway, PF: Pacific Flyway (including Alaska)

[2]The USFWS implemented an improved national harvest survey in 1999. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

[3]Harvest data for the U.S. are preliminary.

Data source: M. H. Gendron and B. Collins (CWS), and R.V. Raftovich *et al.* 2010 (USFWS).

Table 5. Harvest estimates of Northern Pintails in Canada and the United States

	Canada													United States[1] (PF includes Alaska)					Continental
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT NU	YT	Total	AF	MF	CF	PF	Total	Total
1974	939	820	659	790	14 043	8 296	7 545	39 226	69 214	14 281			155 813	34 500	122 900	162 513	928 387	1 248 305	1 404 118
1975	1 092	431	612	787	21 999	9 644	20 611	55 909	81 637	23 758	72	417	216 969	41 200	206 500	273 525	1 045 461	1 566 686	1 783 655
1976	1 507	651	2 663	352	27 578	17 112	17 545	34 693	59 532	38 626	385	277	200 921	42 200	157 100	194 803	928 063	1 322 166	1 523 087
1977	2 438	1 653	1 717	607	39 581	14 333	11 243	20 469	69 905	29 464	137	313	191 860	50 700	213 700	179 906	540 749	985 055	1 176 915
1978	824	829	1 892	1 039	21 298	13 077	21 072	14 051	38 039	22 830	698	216	135 865	35 800	210 600	239 442	851 665	1 337 507	1 473 372
1979	1 693	579	1 056	382	14 958	9 326	19 745	30 588	48 505	17 735	691	287	145 545	48 670	213 600	228 806	829 316	1 320 392	1 465 937
1980	905	510	757	1 384	16 722	13 248	12 872	16 868	44 003	21 392		108	128 769	38 600	215 600	193 055	633 316	1 080 571	1 209 340
1981	1 536	747	951	1 144	17 437	11 977	16 099	2 430	39 745	18 658	91	148	110 963	27 900	208 000	151 027	403 876	790 803	901 766
1982		1 531	1 009	1 479	20 791	10 946	13 290	12 598	29 130	14 021			104 795	38 600	126 500	158 668	467 585	791 353	896 148
1983	2 805	523	694	303	15 867	10 767	11 195	17 056	27 154	13 385	1 864	175	101 788	18 600	187 200	138 918	465 099	809 817	911 605
1984	1 698	1 047	717	908	9 253	10 132	13 131	12 343	34 016	19 661	168	337	103 411	34 600	153 500	165 663	312 492	666 255	769 666
1985	1 459	748	1 460	1 817	16 486	15 345	9 668	8 117	24 051	11 244		810	91 205	21 700	125 000	83 916	292 714	523 330	614 535
1986	634	565	846	1 841	13 163	9 057	6 988	9 077	8 632	8 885		296	59 984	19 000	90 200	72 074	274 961	456 235	516 219
1987	807	2 218	632	1 017	11 864	6 020	5 478	8 386	19 668	10 945		158	67 193	15 800	88 300	122 425	311 417	537 942	605 135
1988	1 998	1 449	486	715	12 160	8 019	13 779	5 320	14 667	10 831			69 424	7 200	39 200	36 392	116 308	199 100	268 524
1989	1 421	660	344	1 406	15 460	11 511	7 560	4 326	11 766	8 549	45		63 048	14 500	65 100	43 595	139 517	262 712	325 760
1990	4 114	450	653	1 707	19 568	8 231	5 279	10 087	13 483	7 750	281	41	71 644	10 500	49 400	43 207	133 164	236 271	307 915
1991	351	542	901	844	9 357	4 742	4 407	4 023	5 689	4 179	112	73	35 220	14 200	40 400	28 687	126 414	209 701	244 921
1992		910	79	464	6 221	4 861	5 236	2 126	6 914	6 393	136	77	33 417	12 200	56 200	31 508	116 250	216 158	249 575
1993	1 090	1 336	852	706	11 401	5 156	5 172	3 253	4 025	4 701	61		37 753	13 000	52 300	42 486	140 620	248 406	286 159
1994	934	765	1 163	1 136	11 307	4 649	4 866	7 302	7 518	4 738		64	44 442	18 000	81 100	61 088	150 361	310 549	354 991
1995	1 727	454	965	1 240	7 831	4 552	8 974	6 521	7 573	4 476			44 313	32 700	136 200	94 351	259 351	522 602	566 915
1996	1 246	478	897	1 234	5 043	4 011	10 323	14 477	9 621	5 367			52 697	19 200	124 000	95 340	281 630	520 170	572 867
1997	785	139	116	493	7 423	5 560	13 248	13 656	13 883	5 422	37		60 762	23 800	145 000	186 191	340 419	695 410	756 172
1998	1 026		653	757	7 735	6 361	14 347	11 099	11 119	6 462	19	276	59 854	33 100	177 000	123 391	238 677	572 168	632 022
1999[2]	390	1 137	755	1 790	8 956	6 457	9 830	10 610	10 304	5 464		0	55 693	25 200	148 299	133 317	232 704	539 520	595 213
2000	470	509	499	581	6 480	5 397	8 766	16 168	13 603	5 825	50		58 348	20 752	155 082	134 252	201 163	511 249	569 597
2001	137		400	610	4 910	3 708	9 215	7 050	8 730	4 806	18	59	39 643	19 276	122 522	135 039	158 115	434 952	474 595
2002	1 153	77	542	702	5 526	9 908	13 878	13 053	7 640	4 549		r	57 028	17 089	102 481	60 469	143 370	323 409	380 437
2003	571	598	227	1 270	6 794	10 420	8 998	8 687	8 204	1 947	234	r	47 950	18 134	123 318	55 080	144 581	341 113	389 063
2004	30	316	129	701	6 393	5 207	12 623	23 801	8 379	2 361		r	59 940	11 226	90 542	62 724	141 540	306 032	365 972
2005	256	313	308	536	4 677	3 178	6 653	13 450	10 769	3 675		r	43 815	17 339	107 276	78 610	203 037	406 262	450 077
2006	176	939	90	382	5 067	4 861	8 579	11 853	12 527	2 004	39		46 517	20 282	104 286	66 313	239 460	430 341	476 858
2007	228	584	660	634	5 533	5 059	13 329	18 054	10 085	2 410	224	r	56 800	19 076	162 416	88 770	251 736	521 998	578 798
2008	427	252	393	427	4 887	5 745	7 911	15 076	12 833	2 989			50 940	21 395	158 218	71 897	285 009	536 519	587 459
2009[3]		190	104	504	4 039	4 684	4 582	17 226	6 138	2 837		2	40 306	15 056	106 727	90 721	286 258	498 762	539 068

[1]AF: Atlantic Flyway, MF: Mississippi Flyway, CF: Central Flyway, PF: Pacific Flyway (including Alaska).

[2]The USFWS implemented an improved national harvest survey in 1999. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

[3]Harvest data for the U.S. are preliminary.

Data source: M. H. Gendron and B. Collins (CWS), and R.V. Raftovich *et al.* 2010 (USFWS).

Table 6. Harvest estimates of Lesser Scaup in Canada and the United States

	Canada													United States[1] (PF includes Alaska)					Continental
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT/NU	YT	Total	AF	MF	CF	PF	Total	Total
1974	3 601	37	688	731	22 326	43 359	16 244	10 698	9 432	1 612			108 728	35 900	330 800	58 855	23 575	449 130	557 858
1975	6 323	166	1 450	943	28 681	43 739	21 748	10 861	18 870	2 661	369	661	136 472	33 200	250 400	48 734	24 456	356 790	493 262
1976	656	89	1 139	238	34 714	50 152	27 108	16 747	14 470	2 243	169	386	148 111	59 100	326 700	96 295	49 009	531 104	679 215
1977	1 033	61	3 552	146	31 895	46 505	11 010	7 250	8 363	3 474	799	237	114 325	199 100	364 400	75 724	45 312	684 536	798 861
1978	1 666	43	1 857		23 451	26 854	14 537	10 400	13 551	3 114	215	341	96 029	39 500	177 300	59 233	38 782	314 815	410 844
1979	241		751	51	26 706	35 097	15 433	7 646	10 827	1 799	571		99 122	19 500	144 600	46 798	40 581	251 479	350 601
1980	2 844	73	662	746	28 850	55 807	27 541	4 910	13 112	1 906	599		137 050	21 100	154 300	34 618	25 958	235 976	373 026
1981	1 607		704	735	31 991	58 463	18 807	3 225	8 980	1 224	507	148	126 391	97 000	326 200	92 567	33 140	547 907	674 298
1982	126		387	309	20 981	37 287	27 394	6 655	13 226	1 721			108 086	39 000	241 000	45 835	31 038	356 873	464 959
1983	471	104	550	575	19 171	42 320	22 289	9 122	6 551	103		78	101 334	34 000	154 500	36 870	43 476	268 846	370 180
1984	1 695	31	352	912	17 696	53 451	18 336	10 861	5 435	975	98	74	109 916	83 900	380 800	151 243	45 752	661 695	771 611
1985	874		365	951	25 866	61 409	15 356	2 498	6 604	1 240	831		115 994	80 600	305 800	71 563	28 489	486 452	602 446
1986	1 839		430	1 646	23 080	47 546	14 674	5 382	5 974	1 191	170		101 932	20 700	164 000	44 452	18 909	248 061	349 993
1987	339	290	615	541	11 981	34 512	10 400	7 129	5 458	1 140		12	72 417	23 100	97 100	44 633	20 408	185 241	257 658
1988		87	943	544	22 429	32 983	6 885	5 019	3 341	496	424		73 151	26 100	84 900	28 418	9 202	148 620	221 771
1989	2 063	52	1 237	1 119	26 710	42 316	7 296	1 347	3 073	608	179		86 000	24 900	69 200	24 097	8 636	126 833	212 833
1990	1 757	35	1 051	1 696	24 047	25 772	6 592	2 557	3 888	778	191		68 364	13 300	58 900	17 035	12 992	102 227	170 591
1991	272		481	455	18 402	31 204	9 226	3 864	2 464	428	37		66 833	11 400	102 600	20 639	15 549	150 188	217 021
1992	1 004		171	116	15 249	24 587	8 227	778	2 320	650	33		53 135	13 200	132 300	28 886	12 712	187 098	240 233
1993	2 231		401	690	20 912	35 173	6 228	2 196	1 628	452	35	40	69 986	13 200	63 700	15 691	13 673	106 264	176 250
1994	510	99	445	244	11 479	27 137	12 344	2 742	3 247	378		52	58 677	20 400	102 000	34 342	20 232	176 974	235 651
1995			334	730	8 705	27 465	14 185	2 263	2 926	242			56 850	26 900	189 000	37 875	31 645	285 420	342 270
1996	178		331	156	7 460	17 344	9 258	2 415	2 800	1 162	331		41 435	35 700	293 800	92 121	38 166	459 787	501 222
1997	232		512	782	6 529	19 843	5 185	4 262	4 863	1 302	431		43 941	41 600	359 800	80 581	28 189	510 170	554 111
1998	1 455		223	1 300	11 513	16 069	5 400	6 287	2 695	311			45 253	61 500	319 300	149 241	30 138	560 179	605 432
1999[2]	470		131	110	8 339	19 599	10 233	2 143	939	181			42 145	70 900	82 900	34 358	21 991	210 149	252 294
2000	26			49	5 071	9 781	11 987	1 284	1 768	178	74	130	30 348	32 400	206 900	85 845	24 798	349 943	380 291
2001	414		60	138	5 082	13 530	8 117	1 777	861	119	128	8	30 234	97 228	165 746	71 646	29 515	364 135	394 369
2002	1 436	548	412	843	5 576	14 259	6 007	1 524	1 791	383		174 r	32 953	84 399	185 381	84 695	35 972	390 447	423 400
2003	682	183	433	265	8 602	11 995	2 376	3 980	2 311	175	117	r	31 119	60 939	153 617	44 850	39 190	298 596	329 715
2004	814		27	186	3 619	9 859	7 362	921	1 593	291		r	24 672	66 091	108 534	66 727	51 531	292 883	317 555
2005	381	304	189	266	3 459	10 088	4 683	2 520	1 777	120		r	23 787	63 698	111 357	54 404	28 105	257 564	281 351
2006	250		172	436	7 219	16 425	4 459	865	2 058	46	97		32 027	46 619	101 219	51 148	33 973	232 959	264 986
2007	146	47	341	209	1 953	10 813	10 291	907	5 852		224	r	30 783	46 594	84 791	40 963	51 092	224 053	254 836
2008	215	33	90	118	3 374	14 647	12 087		7 259	281			38 109	25 791	97 340	28 721	27 709	179 561	217 670
2009[3]		48	247	343	2 710	7 063	8 238	826	7 700	202		22	27 399	35 908	111 522	44 084	30 553	222 067	249 466

[1] AF: Atlantic Flyway, MF: Mississippi Flyway, CF: Central Flyway, PF: Pacific Flyway (including Alaska).

[2] The USFWS implemented an improved national harvest survey in 1999. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

[3] Harvest data for the U.S. are preliminary.

Data source: M. H. Gendron and B. Collins (CWS), and R.V. Raftovich *et al.* 2010 (USFWS).

Table 7. Harvest estimates of Greater Scaup in Canada and the United States

	Canada													United States[1] (PF includes Alaska)					Continental
	NF	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT NU	YT	Total	AF	MF	CF	PF	Total	Total
1974	1 788	314	1 620	488	20 243	18 172	572	532		1 039			44 768	41 800	23 882	1 559	9 823	77 064	121 832
1975	1 321		2 401	283	25 353	36 056	1 136	176	1 215	2 986	69		70 996	29 400	24 342	1 160	10 488	65 390	136 386
1976	3 095		3 622	478	28 190	37 526	1 140	291		1 297			75 539	64 800	20 426	780	11 056	97 062	172 601
1977	2 436	217	1 895	244	21 126	44 900				617		64	71 499	55 300	26 696	3 778	29 157	114 931	186 430
1978	1 611		502	141	17 811	20 465	1 782			320		77	42 709	71 400	20 673	1 787	7 802	101 662	144 371
1979	637		959	97	20 315	26 367	677			1 391			50 443	28 400	13 523	385	7 442	49 750	100 193
1980	3 052	147	738	284	18 922	29 535	720			739			54 237	17 900	17 660	1 661	11 518	48 739	102 976
1981	344		170	818	22 891	23 762	1 139			548			49 672	34 600	27 834	4 137	19 712	86 283	135 955
1982	1 476	63	411	584	15 678	15 797				230			34 239	73 000	11 799	1 381	4 712	90 892	125 131
1983	427		1 289	574	13 443	38 628				924			55 285	22 800	30 966	623	13 454	67 843	123 128
1984	2 565	31	1 098	1 125	18 999	22 538	419	561	133	907			48 376	27 900	23 416	2 746	13 170	67 232	115 608
1985	2 423	428	759	272	17 880	28 128	1 022			134		63	51 109	31 700	21 169	1 517	5 627	60 013	111 122
1986	5 095	404	2 213	1 456	11 638	30 320	970	214	151	1 112			53 573	36 400	10 307	844	7 612	55 163	108 736
1987	1 103		672	1 323	6 941	13 103	746	131		318			24 337	18 000	11 445	1 450	8 817	39 712	64 049
1988	920		3 221	585	13 622	13 859				212			32 419	12 300	6 678	1 381	5 843	26 202	58 621
1989	5 264	51	2 547	1 498	9 380	14 701			182	242			33 865	14 300	6 620	317	3 845	25 082	58 947
1990	3 684	79	1 609	420	9 284	11 959	383		195	81			27 694	7 200	12 257	1 305	5 844	26 606	54 300
1991			1 657	267	6 314	9 815	626	474	387	153			19 693	6 700	5 541	1 930	4 706	18 877	38 570
1992	1 360		805	898	4 830	9 913	298			87			18 191	6 100	7 947	1 217	4 101	19 365	37 556
1993	5 959	176	1 161	362	8 589	8 651	163				21		25 082	8 600	11 522	1 036	5 994	27 152	52 234
1994	706		1 501	307	6 550	8 329	306			26			17 725	6 700	13 146	2 936	6 477	29 259	46 984
1995	508	82	920	542	5 080	12 861	268			97			20 358	14 600	19 758	5 204	13 456	53 018	73 376
1996	596	65	772	914	5 839	7 653	286		297				16 422	11 900	21 391	2 871	13 572	49 734	66 156
1997	677	83	919	1 119	3 627	6 002	157			379			12 963	9 700	23 636	12 687	16 860	62 883	75 846
1998	1 703	169	256	1 878	4 055	4 274	165		162				12 662	12 600	15 353	5 375	12 384	45 712	58 374
1999[2]	1 377		332	55	4 171	4 671	929					3	11 538	10 900	9 138	3 282	12 016	35 336	46 874
2000	1 075		1 157	659	2 961	3 190	120						9 162	12 800	15 644	1 912	12 097	42 453	51 615
2001	1 210		234	1 492	1 537	4 276	747			18			9 514	7 582	8 060	1 811	15 249	32 702	42 216
2002	1 125	77	437	1 517	2 725	4 816	690				151	r	11 538	17 809	30 216	3 591	20 642	72 258	83 796
2003	576	366	524	337	2 100	5 481			173			r	9 557	17 344	14 469	1 257	16 122	49 192	58 749
2004	964	39	90	503	3 040	7 029	285		161	26		r	12 137	17 254	28 056	3 782	22 035	71 127	83 264
2005	447		193	536	1 562	2 840	235						5 813	18 237	24 812	2 518	11 645	57 212	63 025
2006	705	287	191	430	4 002	3 010					19		8 644	10 523	21 454	2 746	13 057	47 780	56 424
2007	619	101	91	165	815	6 764	88			29		r	8 672	13 154	21 964	3 085	32 630	70 833	79 505
2008		41	414	243	1 445	5 876	343		140	35		r	8 537	10 646	24 649	2 656	11 514	49 465	58 002
2009[3]			223	155	912	3 244	540					22	5 096	12 794	24 567	1 668	16 110	55 139	60 235

[1]MF: Mississippi Flyway, CF: Central Flyway, PF: Pacific Flyway (including Alaska).

[2]The USFWS implemented an improved national harvest survey in 1999. The results for years prior to 1999 are not directly comparable to those from 1999 onward.

[3]Harvest data for the U.S. are preliminary.

Data source: M. H. Gendron and B. Collins (CWS), and R.V. Raftovich *et al.* 2010 (USFWS).